176911

Exhibit 1

Site Topographic Map

found to increase and decrease with depth (See Exhibit 2, Table 3). Four excavations (EX-1 through EX-4) were sampled on Trust 454 property. One of these excavations revealed an 18-inch thick layer of broken battery casing and slag material. Also, the results indicate that although the lead content tends to vary with depth and some increase with depth is observed, it rapidly and uniformly falls to low levels as a clay layer is encountered at about one to two feet depth (See Exhibit 3). This initial increase in lead content could reflect historic waste disposal by previous occupants as the layer of broken battery casings found in EX-1 seems to indicate.

Feasibility Study Report

5. Page 5, Section I.3.3, Paragraph 2, Sentences 2 and 3

   See Comment #3.

6. Page 6, Section 1.3.3, Paragraph 1, Sentence 1

   See Comment #3.

7. Page 6, Section 1.3.3, Paragraph 1, Sentence 4

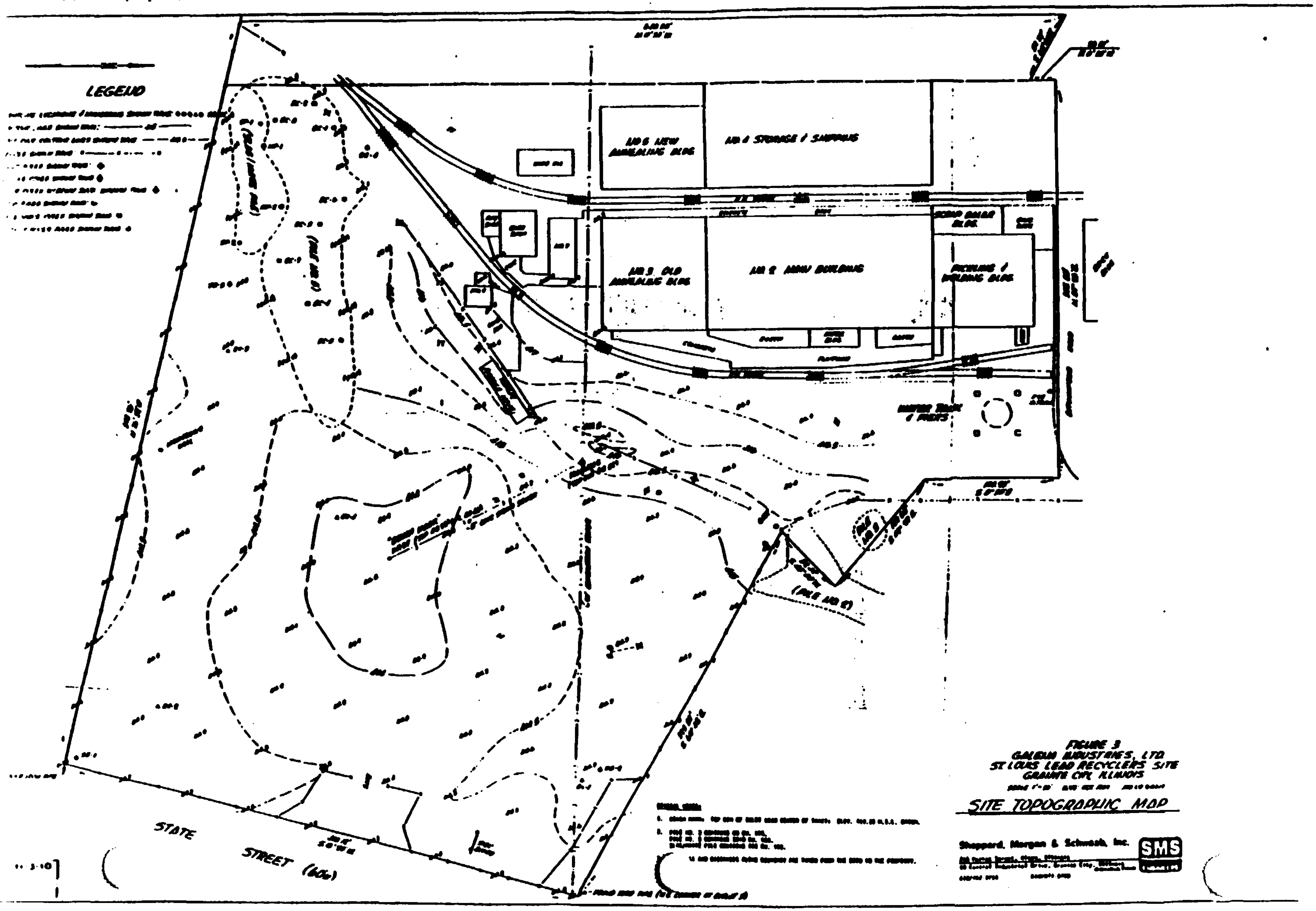
   The Consent Decree signed by IEPA and SLLR required a number of actions by SLLR to control fugitive dust (including paving) upon recommencement of any lead waste recycling activity. SLLR applied asphalt material to the gravel road in compliance with the Consent Decree. However, since SLLR has not recycled any lead waste since March 1983, the asphalt has not been reapplied.

Exhibit, Page 5-30, Section 5.9, Paragraph 2, Sentence 2

See Comment #2 regarding lead content of the ebonite (rubber chips).

Exhibit 2

Summary of Soil and Wastepile Analyses


LEGEND
NO. 6 NEW ANNEALING BLDG
NO. 4 STORAGE & SHIPPING
NO. 3 OLD ANNEALING BLDG
NO. 2 MAIN BUILDING
PICKLING & BOILING BLDG
SCRAP BALER BLDG
WATER TANK & PUMPS
STATE STREET (60')
FIGURE 3
GALEAM INDUSTRIES, LTD
ST LOUIS LEAD RECYCLERS SITE
GRANITE CITY, ILLINOIS
SITE TOPOGRAPHIC MAP
Sheppard, Morgan & Schwaab, Inc.
SMS

ATTACHMENT A

**St. Louis Lead Recyclers
Comments on Documents
Related to NL Industries/
Taracorp Site, Granite City, Illinois**

U.S. EPA Proposed Plan

1. Page 2, Paragraph 2, Sentences 1 and 3

   Although St. Louis Lead Recyclers (SLLR) leased the building from Trust 454 and begin installing equipment in August, 1980, and accepted limited quantities of waste pile material starting in July 1981 for process development purposes, SLLR did not start full-scale recycling of lead waste from the Taracorp pile until April, 1982; SLLR shut down all operations due to a contractual dispute with Taracorp on March 21, 1983.

2. Page 3, Paragraph 3, Sentences 3 and 4

   The volumes and lead content of the piles on Trust 454 property are incorrect. A recent survey conducted for SLLR by SMS Engineers (See Exhibit 1) found that there are 3,640 cubic yards of rubber chips and 416 cubic yards of slag and mattes on Trust 454 property. Samples of the rubber chips, slags, and matte were analyzed for EP Toxic and total metals. In addition, a sample of each material was analyzed for the TCCP list of parameters, reactivity, and corrosivity. The total lead content of the battery chips varied from one percent to four percent. The slag and matte continued from four to fifteen percent and 0.3 to 0.35 percent respectively (see Exhibit 2, Table 1 for a summary of the analytical results). The lead content in these results are an order of magnitude lower than the results reported in the Proposed Plan as well as the RI and FS reports.

3. Page 3, Paragraph 5, Sentences 3 and 5

   Same as comment number 2. In addition, the unpaved area is reported as having a surface lead concentration of 9,250 mg/kg. This is a misleading statement implying that the lead content of surface soil throughout the Trust 454 property is 9,250 mg/kg. However, since the soil sample that contained that high concentration was collected near the edge of rubber chip pile 3, it should not be used to reflect the lead content of Trust 454 surface soil as a whole. As our sampling results indicate the lead content of the surface soils on Trust 454 property (SS-1 through SS-4) (See Exhibits 2, Tables 1 and 2) varies from about 1,000 ppm in the southeast corner of the site to 9,540 ppm near the rubber chip pile. In addition, the

DAMES & MOORE A PROFESSIONAL LIMITED PARTNERSHIP
11701 BORMAN DRIVE, SUITE 340, ST. LOUIS, MISSOURI 63146
(314) 993-4599 FAX NO. (314) 993-4895

March 12, 1990

Ms. Mary Ann Croce LaFaire
Community Relations Coordinator
U.S. EPA (5PA-14)
230 South Dearborn Street
Chicago, IL 60604

RE: NL Industries/Taracorp Site-Comments of St. Louis Lead Recyclers ("SLLR") to Draft Feasibility Study and Proposed Plan

Dear Ms. LaFaire:

We have reviewed the Draft Feasibility Study for the Taracorp Site in Granite City, Illinois, dated August 1989, the Addendum to the Draft Feasibility Study Report, dated January 10, 1990, the U.S. EPA's Proposal Plan for the NL Industries/Taracorp Site, Granite City, Illinois, dated January 10, 1990. SLLR would like to comment on several errors contained in these documents. Our comments are enclosed as Attachment A. Please include these comments in the Administrative Record.

Should you have any questions or require further information, please do not hesitate to contact me.

Very truly yours,

DAMES & MOORE
A Professional Limited Partnership

Neil Jost

Neil J. Jost, P.E.
Associate

njj/ket
Enclosure
cc: Steven McAllister, Galena Industries
Jim Stack, Galena Industries
George von Stamwitz, Esq.
Donald J. Harvey, Dames & Moore

EXHIBIT
A

7. SLLR will be represented in these negotiations on legal issues by:

George M. von Stamwitz, Esq.
Armstrong, Teasdale, Schlafly, Davis & Dicus
One Metropolitan Square, Suite 2600
St. Louis, Missouri 63102-2740
(314) 621-5070; and

on technical issues by:

Neal Jost
Dames & Moore
11701 Borman Drive, Suite 340
St. Louis, Missouri 63146
(314) 993-4599

8. SLLR's willingness to perform the remedy is conditioned upon the receipt of the broadest release from liability allowed by law, and a commitment by USEPA and IEPA that the performance of the remedy satisfies all the requirements of other state and federal programs which have, or potentially have, jurisdiction over the rubber chip pile.

We look forward to initiating negotiations on a consent decree and promptly resolving the issues relating to SLLR's involvement at this Site. If you have any questions or comments about the position of SLLR, please contact me.

Very truly yours,

George M. von Stamwitz
For: St. Louis Lead Recyclers

GMS:kb

cc: Andrew R. Leeper, Esq.
Stephen E. McAllister
Neal Jost

The following commitments, together with the attachments to this letter, constitutes SLLR's Good Faith Offer for performing portions of RD/RA which are related to SLLRs divisible involvement at the Site:

1. SLLR is willing to excavate the rubber chip pile located on Trust 454 property and any soil directly beneath or around the rubber chip pile impacted by the pile to the depth of six (6) inches, and remove such excavated material to the NL/Taracorp pile.

2. As indicated previously, SLLR's involvement at the NL/Taracorp Site is clearly divisible from the owners/operators and generators of the NL/Taracorp pile; therefore, SLLR proposes only to deal with that portion of the Record of Decision which involves the rubber chip pile. The ROD contains numerous inaccuracies regarding the rubber chip pile and as does the RI/FS documents drafted by NL. SLLR submitted comments to the Proposed Plan to correct these inaccuracies. A copy of these comments is attached as Exhibit A.

3. A Statement of Work is attached hereto as Exhibit B. This document identifies how SLLR plans to proceed with the Work. SLLR will develop in conjunction with USEPA a more detailed statement of work for purposes of the final consent decree.

4. SLLR has the technical capacity to undertake the RD/RA. SLLR has retained Dames & Moore as its consultant for this matter.

5. Upon acceptance of this offer, SLLR will negotiate a financial assurance provision in the Consent Decree providing for either a letter of credit, third-party guarantee, a performance bond or a financial test.

6. SLLR is willing to enter into a reasonable agreement with USEPA regarding direct oversight costs for that portion of the response at the NL/Taracorp Site to be conducted by SLLR.

returned to the Pile. In essence, SLLR's process was a closed circular stream of material from the NL/Taracorp Pile back to Taracorp in the form of product and slag. In short, SLLR reduced the amount of waste to be remediated at the Site.

SLLR's role at the Site as a recycler supports a resolution of its potential liability independent from the other PRPs. The only impact on the Site caused by SLLR is the movement of waste from the large pile to the smaller rubber chip pile and the removal of lead from those wastes. As such, SLLR's involvement at the NL/Taracorp Site is clearly divisible. SLLR is not a PRP for the larger pile or for wastes that went into NL's or Taracorp's process. Accordingly SLLR does not face the prospect of joint and several liability at the Site. See United States v. Chem-Dyne, 572 F.Supp. 802 (S.D. Ohio 1983) ("If the harm is divisible and if there is a reasonable basis for apportionment of damages, each defendant is liable only for the portion of harm he himself caused." Id. at 811).

While the generators and owners/operators, whose hazardous waste created the NL/Taracorp pile was transshipped to SLLR, are strictly liable for the rubber chip pile as generators, SLLR, in a good faith effort to resolve its liability at the NL/Taracorp Site, is prepared to assume responsibility in the first instance for addressing the wastes located at the former SLLR facility; that is, address the divisible portion of the total Site which is linked to SLLR. In general, SLLR is prepared to excavate the rubber chip pile, combine this material with the NL/Taracorp pile and excavate soil beneath and around the rubber chip pile to the depth of six (6) inches. The activities SLLR is prepared to undertake are described in more detail below and in the attached Statement of Work.

SLLR has elected not to join the Group of generators which has been formed to respond to EPA's Special Notice Letter. SLLR was erroneously listed as the seventeenth (17) largest generator of the NL/Taracorp pile on the Waste-In List notwithstanding the fact that SLLR was not a generator at all. Due to time constraints, the Group has not been willing to resolve SLLR's status before the Group responds to the Special Notice Letter and thus, the Group demanded a proportional financial commitment from SLLR far in excess of SLLR's exposure.

ARMSTRONG, TEASDALE, SCHLAFLY, DAVIS & DICUS
A PARTNERSHIP INCLUDING PROFESSIONAL CORPORATIONS
ATTORNEYS AND COUNSELORS
ONE METROPOLITAN SQUARE
ST. LOUIS, MISSOURI 63102-2740
(314) 621-5070
TELECOPIER (314) 621-5065

George M. von Stamwitz
(314) 342-8017

KANSAS CITY, MISSOURI
BELLEVILLE, ILLINOIS
OVERLAND PARK, KANSAS

August 31, 1990

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. Brad Bradley (5HS-11)
United States Environmental
Protection Agency
230 South Dearborn Street
Chicago, Illinois 60604

RE: NL Industries/Taracorp Site
Granite City, Illinois
Response to Special Notice Letter by St. Louis Lead Recyclers

Dear Mr. Bradley:

This correspondence will formally respond to USEPA's Special Notice Letter dated June 25, 1990, on behalf of St. Louis Lead Recyclers ("SLLR"). The statements and commitments in this letter are made only for purposes of seeking a settlement and do not constitute an admission of liability for the remediation at the NL/Taracorp Site ("Site").

As explained in detail in SLLR's response to the §104(e) request, SLLR did not generate any waste designated for the NL/Taracorp Site within the meaning of CERCLA. Rather, SLLR was hired by Taracorp to recycle the pile. All of the material handled by SLLR originated from the pile itself; there was no other source of lead bearing materials to SLLR's process other than the NL/Taracorp pile. SLLR's process ran for approximately one year when it ceased because of Taracorp's bankruptcy proceeding.

SLLR's process separated material from the NL/Taracorp Pile into five components: metallic grid lead, lead oxide paste, plastic case material, hard rubber case material and slag and other trash. Material was given back to Taracorp in three forms pursuant to the tolling contract: metallic lead blocks (approximately 2,000 pounds each) lead oxide paste which was returned to Taracorp for the production of lead products; slag and trash materials, which were screened out of SLLR's process were

DAMES & MOORE A PROFESSIONAL LIMITED PARTNERSHIP

EXHIBIT B

ST. LOUIS LEAD RECYCLERS' STATEMENT OF WORK

1.0 Introduction

This Statement of Work (SOW) describes in general terms the activities for remediating certain lead-bearing materials proposed by St. Louis Lead Recyclers (SLLR) for the NL/Taracorp site located in Granite City, Illinois.

2.0 Background

The SLLR facility operated between May 1982 and March 1983 as a recycler of lead from the adjacent NL/Taracorp slag/battery waste pile. This waste pile was place on the National Priorities List of Superfund Sites on June 10, 1986. The Record of Decision for the NL/Taracorp Site was issued by USEPA in January 1990. This ROD called for the excavation of lead-contaminated materials and consolidation with the NL/Taracorp waste pile under an impermeable cover. This SOW was developed using this remedy as a basis.

SLLR removed approximately 11,000 tons of material from the Taracorp/NL Industries waste pile, and returned about 5,400 tons as unrecyclable slag, matte and trash. The remaining 5600 tons was then processed by SLLR which returned approximately 230 tons of elemental lead and 2800 tons of lead oxide (a generic term that refers to a mixture primarily composed of lead dioxide and lead sulfate). It is estimated that as much as 95% of the lead was removed from the processed material.

The hard rubber chips that exited the SLLR process were accumulated over the approximately seven (7) months of operation in a pile placed on Trust 454 property (see Figure 3). Recent measurements by a surveyor indicated that there are 3640 cubic yards of rubber chips and 416 cubic yards of slag and matte.

3.0 Proposed Action

It is proposed to remove the rubber chip, slag, and matte waste piles from the Trust 454 property and consolidate them into the NL/Taracorp pile. The top six inches of soil will be removed from underneath the rubber chip, slag, and matte waste piles including a 10-foot buffer zone, and an area between the piles and the SLLR facility's west entrance. Approximately 750 yd^3 of soil will be excavated. The excavated areas will be backfilled with clean soil and reseeded. Dust control measures and air monitoring will be implemented during the excavation to ensure worker and community health and safety.

A detailed work plan including health and safety plan will be prepared.

All construction work will be overseen by an independent engineer who will prepare of final report.

Should you have any questions or require further information, please do not hesitate to contact me.

Very truly yours,

DAMES & MOORE
A Professional Limited Partnership

Neil J. Jost
Associate

NJJ/ken
[njj/vons0828.ltr]

Consistent with the enclosed Statement of Work we also recommend the following modification to your draft letter to USEPA dated August 22, 1990:

We recommend adding at the end of paragraph 3 that it is estimated that up to 95% of the lead was removed from the material taken from the NL/Taracorp pile.

We recommend modifying paragraph 6 to indicate that the top six inches of soil will be excavated and consolidated (along with the chip, matte and slag piles) with the NL/Taracorp wastepile. It should be also noted here that although the ROD calls for excavation of any soil (in Area 1) with a lead content above 1000 ppm, SLLR believes that for various reasons related to limited SLLR activities at the Site (listed below) that the major source of lead in Site soils is the former smelter operations and that SLLR's contribution to lead in soils in minimal. For this reason removal of the top six inches of soil is a fair contribution by SLLR to the overall remedy at the Site.

Although there are no data that we are aware of that would allow us to quantify SLLR's contribution to the lead observed in soils, there are several reasons for concluding that SLLR's contribution to lead in Site soils was minimal; these include:

1. Excavation of soils at the Trust 454 property (see February 22, 1990 RCRA Closure Plan) indicates the smelter activities reached into the Trust 454 property as evidenced by the presence of an 18-inch layer of broken battery casings, grid lead and slag pieces found on the property. The extent of this layer of debris is unknown. Information describing the full scope of past NL activities on what is now Trust 454 property is unavailable.

2. We believe smelter "fallout" or deposition resulting from airborne fugitive or point source emissions from the smelter and related operations contributed to substantial surface and subsurface soil contamination at the site and in residential areas bordering the Taracorp/NL facility; the result of over 90 years of NL/Taracorp operations. SLLR's "outside" activities, including transport and sorting of the wastepile material and cleaned rubber chips, had limited impact because such activities were of very brief duration, compared to smelter activities (one year versus 90 years of operation, respectively).

3. The lead remaining on the rubber chips in the chip pile would not be leached in significant quantities by rainfall since the most of the leachable lead has already been removed through SLLR's battery waste recycling process includes rigorous contact with proprietary cleaning solutions. It is estimated that as much as 95% of the lead from the wastepile material was removed and recycled.

For these supporting reasons, then, a restoration of the site so its pre-SLLR condition entailing soil removal should be satisfactory to EPA that SLLR has made a substantial contribution to countering its actions during the time of operation.

DAMES & MOORE A PROFESSIONAL LIMITED PARTNERSHIP
11701 BORMAN DRIVE, SUITE 340, ST. LOUIS, MISSOURI 63146
(314) 993-4599 FAX NO. (314) 993-4895

August 31, 1990

Mr. George Von Stamwitz
Armstrong, Teasdale, Schlafly, Davis & Dicus
611 Olive Street, Suite 1900
St. Louis, MO 63101

RE: Comments on the Response to Special Notice Letter to USEPA and Scope of Work
Dames & Moore Job Number: 19076-003-045

Dear George:

Herewith are the Statement of Work and comments on the subject letter. The activities described in the Statement of Work can be summarized as follows:

- Removal of the rubber chip, slag, and matte waste piles from the Trust 454 property and consolidation into the NL/Taracorp pile.
- Excavation of the top six inches of soil from underneath the rubber chip, slag, and matte waste piles including a 10-foot buffer zone and area between the piles and the SLLR facility entranceway. Replacement with clean fill or gravel.
- Preparation of work plans including health and safety plan.
- Air monitoring during remedial activities for worker and community health and safety.
- Oversight of contractor and preparation of final report.

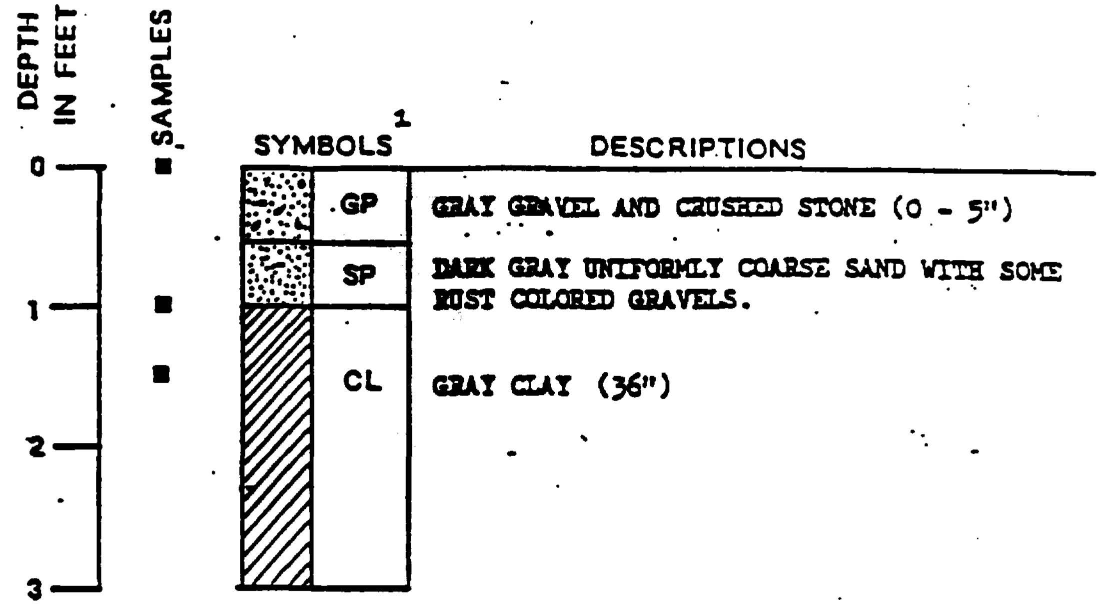
We estimate that the remedial action described above will cost approximately $84,000.

Also, per your request, we estimate that effect of SLLR's recycling activities and the proposed remedial action will slightly decrease the overall volume of the large wastepile. We compared estimates of the amount of recycled material to the volume of soil proposed for excavation. Approximately 2025 yd^3 of lead, lead oxide and plastic were removed from the large wastepile and recycled. This compares to approximately 750 yd^3 of soil to be excavated.

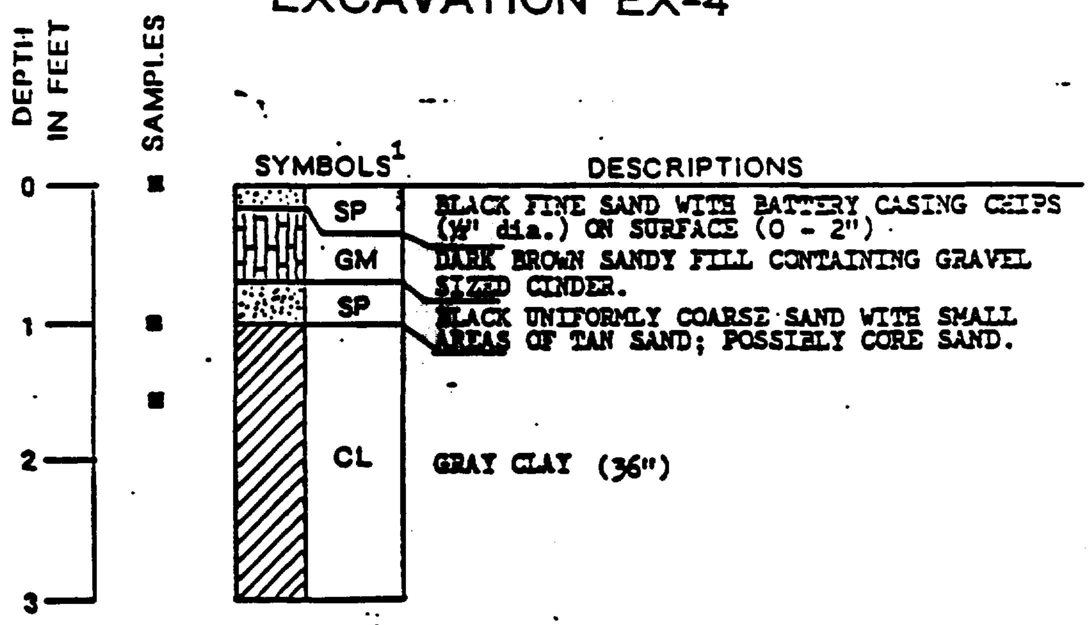
From Jim Stack's observations, as much as 8300 yd^3 of pile material (unexpanded from transport) was removed from the Taracorp pile. We believe milling and recycling reduced this volume significantly, but it is difficult to quantify. The total volume of material (waste pile and excavated soil) to be returned to the Taracorp pile under this scenario is 4810 yd^3.

EXHIBIT
3

EXCAVATION EX-3



EXCAVATION EX-4



[1] United Soil Classification System

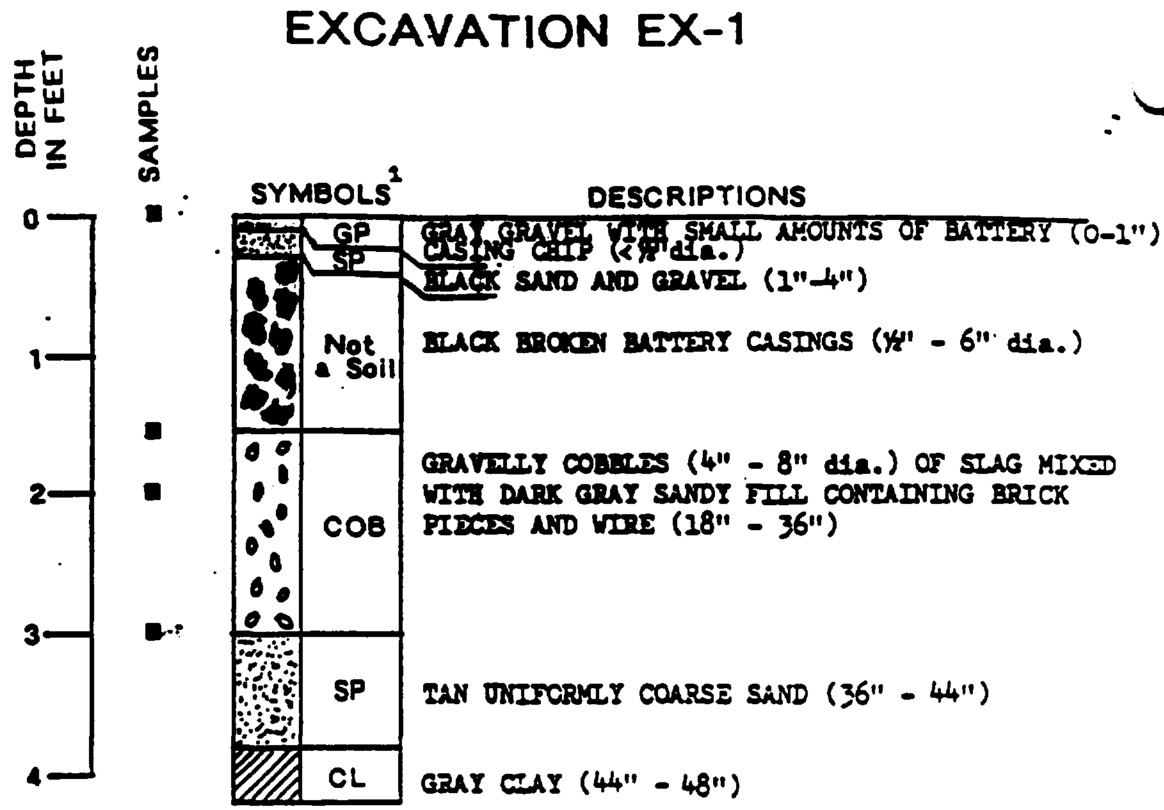
■ Samples collected with clean trowels from face of excavation.

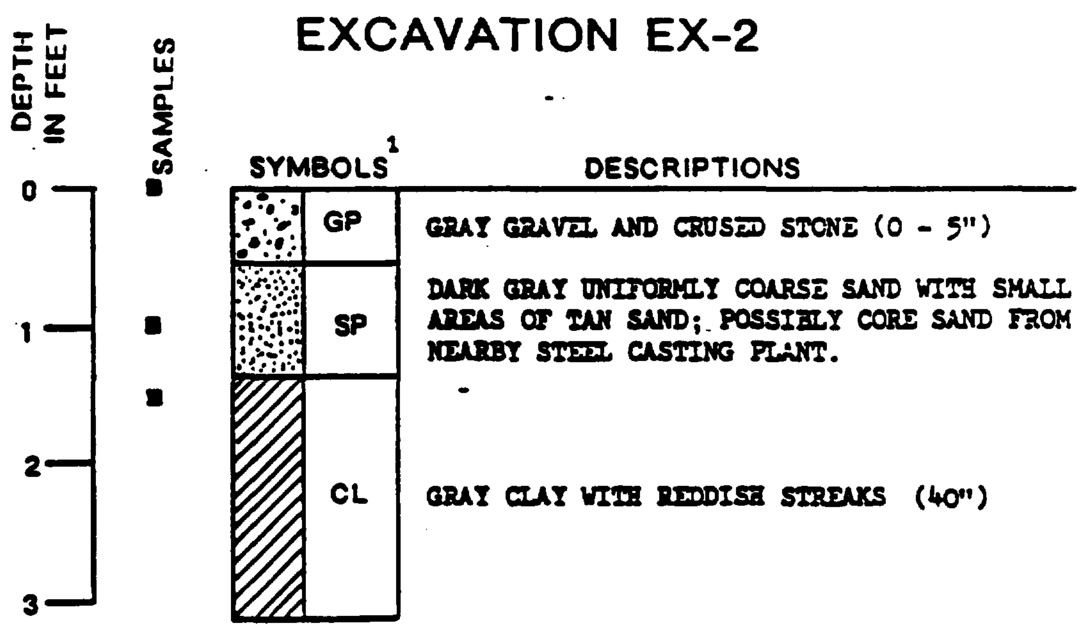
FIGURE 1B

EXCAVATION LOGS

ST. LOUIS LEAD RECYCLERS
Granite City, Illinois

Dames & Moor





[1] United Soil Classification System

■ Samples collected with clean trowels from face of excavation.

FIGURE 1A

EXCAVATION LOGS

ST. LOUIS LEAD RECYCLER

Granite City, Illinois

Dames & Moor

Exhibit 3

Excavation Logs

TABLE 3

SUMMARY OF EXCAVATION ANALYTICAL RESULTS

Site Identification	Depth of Sample	Total Lead Concentration (mg/kg)[1]
EX1	0"	3,310
EX1	18"	57,400
EX1	24"	701
EX1	36"	1,660
EX2	0"	988
EX2	12"	<11.4
EX2	18"	50.9
EX3	0"	8,880
EX3	12"	15,000
EX3	18"	<17.2
EX4	0"	2,200 (1,750)
EX4	12"	1,220
EX4	18"	11.9

Notes:

[1]mg/kg = ppm
( ) = duplicate

TABLE 2

ORGANIC RESULTS - WASTE CHARACTERIZATION (TCLP)
(continued)

Parameter	MP-1 (5807)	SP-1 (5809)	BC-3 (5813)
	Sample Concentration (PPB)		
Volatile Compounds			
Acrylonitrile	ND	ND	ND
Benzene	ND	10.85	ND
Carbon Disulfide	ND	ND	ND
Carbon Tetrachloride	ND	ND	ND
Chlorobenzene	ND	ND	ND
Chloroform	ND	4.21	ND
1,2-Dichloroethane	ND	ND	ND
1,1-Dichloroethylene	ND	ND	ND
Isobutanol	ND	ND	ND
Methylene Chloride	12.74	14.93	3.49
Methyl ethyl ketone	ND	ND	ND
1,1,1,2-Tetrachloroethane	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND
Tetrachloroethylene	1.93	5.55	ND
Toluene	25.47	55.94	4.42
1,1,1-Trichloroethane	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND
Trichloroethylene	ND	3.93	ND
Vinyl Chloride	ND	ND	ND

NOTE:

ND = Not Detected

TABLE 2

ORGANIC RESULTS - WASTE PILE CHARACTERIZATION (TCLP)

Parameter	Sample Concentration (PPB) MP-1 (5807)	SP-1 (5809)	BC-3 (5813)
Herbicides[1]			
2,4-Dichlorophoxyacetic Acid (2,4-D)	<0.17	<0.17	<0.17
2,4,5-TP Silver	<0.043	<0.043	<0.043
Pesticides			
Lindane	<0.003	<0.003	<0.003
Endrin	<0.028	<0.028	<0.028
Methoxychlor	<0.153	2.9	<0.153
Toxaphene	<0.357	<0.357	<0.357
Chlordane	<0.071	<0.071	<0.071
Heptachlor	0.025	0.008	0.013
Semi-Volatile Compounds			
Bis(2-chloroethyl)ether	ND	ND	ND
Cresols(and cresylic acid)	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND
2,4-Dinitrotoluene	ND	ND	ND
Hexachlorobenzene	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND
Hexachloroethane	ND	ND	ND
Nitrobenzene	ND	ND	ND
Pentachlorophenol	ND	ND	ND
Phenol	ND	ND	ND
Pyridine	ND	ND	ND
2,3,4,6-Tetrachlorophenol	ND	ND	ND
2,4,5-Trichlorophenol	ND	ND	ND
2,4,6-Trichlorophenol	ND	ND	ND

NOTE

[1] Herbicides could not be run using TCLP protocol due to significant interferences. Therefore, herbicide concentrations are reported on EP Toxicity extractions.

ND = Not Detected

TABLE 1 (CONTINUED)
WASTE PILE AND SOIL CHARACTERIZATION DATA - INORGANIC ANALYSES (MG/KG)

Parameter	SS-1 (5799)	SS-1 SUB (5800)	SS-2 (5801)	SS-2 SUB (5802)	SS-3 (5803)	SS-3 SUB (5804)	SS-4 (5805)	SS-4 SUB (5806)	WP-1 (5807)	WP-2 (5808)	SP-1 (5809)	SP-2 (5810)
Hg (EP)	<0.0002	<0.0002 (<0.0002)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Pb (EP)	0.412 (0.418)	<0.066	9.150	74.00	2.470	13.40	1.110	1.110	0.449	1.630	1,192.0	378.0
Se (EP)	<0.200 (<0.200)	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200
Corrosivity	NR	NR	NR	NR	NR	NR	NR	7.00	9.53 (4.50)	9.46	6.75	NR
Reactivity - Cn	NR	NR	NR	NR	NR	NR	NR	NEG	NEG	NR	NEG	NR
Reactivity-S	NR	NR	NR	NR	NR	NR	NR	NEG (NEG)	NEG	NR	NEG	NR
Ag (TCLP)	NR	NR	NR	NR	NR	NR	NR	NR	<0.050 (<0.050)	NR	<0.050 0.329	NR
As (TCLP)	NR	NR	NR	NR	NR	NR	NR	NR	<0.200 (<0.200)	NR	<0.050 0.329	NR
Ba (TCLP)	NR	NR	NR	NR	NR	NR	NR	NR	<0.250 (<0.250)	NR	<0.7746	NR
Cd (TCLP)	NR	NR	NR	NR	NR	NR	NR	NR	<0.020 (<0.020)	NR	<0.020	NR
Cr (TCLP)	NR	NR	NR	NR	NR	NR	NR	NR	<0.100 (<0.100)	NR	<0.100	NR
Hg (TCLP)	NR	NR	NR	NR	NR	NR	NR	NR	<0.0002	NR	<0.0002	NR
Pb (TCLP)	NR	NR	NR	NR	NR	NR	NR	NR	<0.100 (<0.100)	NR	980	NR
Se (TCLP)	NR	NR	NR	NR	NR	NR	NR	NR	<0.200 (<0.201	NR	<0.200	NR

Notes: EP = EP toxicity extraction; TCLP = TCLP extraction. ( ) = duplicate

TABLE 1 (CONTINUED)
WASTE PILE CHARACTERIZATION DATA - INORGANIC ANALYSES @(MG/KG)

Parameter	BC-1 (5811)	BC-2 (5812)	BC-3 (5813)	BC-4 (5814)	BC-5 (5815)	BC-6 (5816)	BC-7 (5817)	BC-8 (5818)
Reactivity -	NR	NR	NEG	NR	NR	NR	NR	NR
Ag (TCLP)	NR	NR	<0.050	NR	NR	NR	NR	NR
As (TCLP)	NR	NR	<0.027	NR	NR	NR	NR	NR
Ba (TCLP)	NR	NR	<0.361	NR	NR	NR	NR	NR
Cd (TCLP)	NR	NR	<0.020	NR	NR	NR	NR	NR
Cr (TCLP)	NR	NR	<0.010	NR	NR	NR	NR	NR
Hg (TCLP)	NR	NR	<0.0002 (<0.0002)	NR	NR	NR	NR	NR
Pb (TCLP)	NR	NR	173	NR	NR	NR	NR	NR
Se (TCLP)	NR	NR	<0.200	NR	NR	NR	NR	NR

TABLE 1 (CONTINUED)
WASTE PILE AND SOIL CHARACTERIZATION DATA - INORGANIC ANALYSES @(MG/KG)

Parameter	BC-1 (5811)	BC-2 (5812)	BC-3 (5813)	BC-4 (5814)	BC-5 (5815)	BC-6 (5816)	BC-7 (5817)	BC-8 (5818)
Ag	<0.85	1.04	<0.75	0.92	<0.85	<0.85	<0.85	<0.70
As	798.7	398.2	252.3	724.4	250.4	280.4 (33.5)	178.0	143.4
Ba	73.7	189	134	75.8	70.9	66.8	161	88.1
Cd	1.5	1.2	3.1	7.2	1.6	2.4	4.1	2.1
Cr	5.8	8.0	8.2	8.8	10.2	5.6	33.0	7.4
Hg	0.21	0.25	0.38	0.65	3.95	0.22	0.26	0.18
Pb	22,600	10,600	21,900	42,700	24,200	32,100	27,900	14,600
Se	<2.72	2.65	3.13	<1.93	3.30	<2.72	<2.72	<2.22
Ag (EP)	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
As (EP)	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200
Ba (EP)	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	<0.200
Cd (EP)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Cr (EP)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hg (EP)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Pb (EP)	70.60	49.50	0.942	46.30	28.60	123.00	76.60	27.2
Se (EP)	0.221	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200
Corrosivity	NR	NR	6.48	NR	NR	NR	NR	NR
Reactivity - CN	NR	NR	NEG	NR	NR	NR	NR	NR

TABLE 1
WASTE PILE AND SOIL CHARACTERIZATION DATA - INORGANIC ANALYSES B(MG/KG)

Parameter	SS-1 (5799)	SS-1 SUB (5800)	SS-2 (5801)	SS-2 SUB (5802)	SS-3 (5803)	SS-3 SUB (5804)	SS-4 (5805)	SS-4 SUB (5806)	WP-1 (5807)	WP-2 (5808)	SP-1 (5809)	SP-2 (5810)
Ag	<0.79	<0.77	<0.82	<0.86	<0.79	<0.81 (0.106)	<0.81	<0.76	<0.73	<0.75	<0.83	1.69
As	40.8	61.2	34.3	12.5	28.2	41.0 (33.5)	219.2	346.4	<0.48	1.12	3767	2655
Ba	96.1	22.1	391.0	72.8	366.0	1890 (1660)	119	533	472	368	270	559
Cd	3.7	0.29	3.0	5.0	2.7	20.2 (35.3)	5.3	7.1	54.4	17.2	223	8.8
Cr	21.5	3.7	103	11.4	18.1	2350 (359)	28.8	39.8	56.1	79.8	56.1	79.8
Hg	0.13	<0.10 (<0.10)	<0.10	0.14	<0.10	35.7	0.85	1.38	<0.10	<0.10 (<0.10)	0.12	<0.10
Pb	1660	57.5	3140	28,100	1070	11,200 (13,900)	9560	16,700	2950	3460	149,000	63,800
Se	0.60	0.53	1.62	--	3.66	<0.51 (<0.52)	0.89	--	--	--	3.02	42.6
Ag (EP)	<0.050 (<0.050)	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
As (EP)	<0.200 (<0.200)	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200
Ba (EP)	0.701 (0.693)	<0.250	0.700	0.335	0.760	1.09	0.270	0.282	0.567	0.856	<0.250	<0.250
Cd (EP)	<0.020 (<0.020)	<0.020	0.024	0.020	<0.020	0.211	0.022	0.024	0.035	0.057	0.770	0.062
Cr (EP)	<0.001 (<0.001)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

3-4-
7-4-9?

PRP COMMITTEE FOR THE NL INDUSTRIES/TARACORP SITE

Contact:

Dennis P. Reis
Sidley & Austin
One First National Plaza
Suite 5400
Chicago, IL 60603

August 31, 1990

Brad Bradley (5HS-11)
United States Environmental
Protection Agency
230 South Dearborn Street
Chicago, IL 60604

Re: NL Industries/Taracorp Site, Granite City, IL

Dear Mr. Bradley:

I. **Introduction.**

This correspondence constitutes the good faith offer of the parties identified in Exhibit A in response to the Special Notice Letter issued by the United States Environmental Protection Agency ("U.S. EPA") for the NL Industries/Taracorp Superfund Site in Granite City, Illinois. In making the offer, the parties express their willingness to conduct an RD/RA. The offer is made without any admission of fact or liability by any of the parties listed in Exhibit A, and each party reserves all rights it may have at law or in equity to maintain or defend against any claim or demand whatsoever concerning the Granite City site and surrounding area. In addition to this correspondence (which summarizes the offer, responds to and comments on certain aspects of the Special Notice Letter, Record of Decision, and Scope of Work, and discusses matters collateral to the offer), the good faith offer consists of the following documents:

- Exhibit A, a list of parties who are participating in this good faith offer.
- Exhibit B, a critique of U.S. EPA's use of the Integrated Uptake/Biokinetic Model as discussed in Appendix B of Attachment I to the Special Notice Letter. This document constitutes a portion of our element by element response to the agency's Record of Decision.

GC 106929

- Exhibit C, a revised Scope of Work, which serves as our element by element response to the agency's Scope of Work and a description of the work plan.

- Exhibit D, comments and, where appropriate, proposed revisions to the Model Consent Decree. This exhibit incorporates our willingness to reimburse U.S. EPA for oversight costs as set forth in CERCLA and our position on release from liability and reopeners to liability.

II. Parties participating in this good faith offer.

Over the course of recent months, U.S. EPA has identified as potentially responsible parties 362 vendors or customers of the facility operated by NL Industries and Taracorp for the better part of this century. The parties fashioning this offer are a subset of the 362 identified by the agency. Please note that the list of parties to this offer does not include NL Industries.[1] The parties to this offer and NL Industries have settled neither their potential differences about sharing costs incurred in cleaning the smelter NL Industries owned and operated for half of this century nor the form a good faith offer should take. Consequently, we[2] have not been able to form a group which includes NL Industries. Nevertheless, we are aware that NL Industries is also making an offer to U.S. EPA. While we have been apprised of the general outline of the offer during negotiations, we are not privy to its final form. We assume U.S. EPA would prefer that the parties participate in a common effort and will continue to push the parties in that direction.

---

[1] We are aware that the smelter was operated for a few years by Taracorp. We understand that Taracorp has been subject to a bankruptcy proceeding and that NL Industries and Taracorp have entered into a settlement in which NL Industries may have agreed to indemnify Taracorp for any claims resulting out of the conduct of certain response activities at the site. Since NL Industries ran the facility for a substantial portion of its operations and Taracorp has not actively participated in response activities to date, for the present, we regard NL Industries as the principal party with which we must settle our disputes about the propriety of requiring customers to clean up a business run by a viable operator. Nevertheless, we waive no rights against Taracorp.

[2] The term "we" as used throughout this letter refers to the parties to this offer.

However, until we reach agreement, our offer must remain contingent on the inclusion of NL Industries in the final consent decree.

As certain parties to this offer noted to U.S. EPA during the period before issuance of the Special Notice Letter, it is difficult to focus the attention of identified potentially responsible parties until after receipt of the Special Notice Letter. When the list is as expansive as that issued by U.S. EPA, it invariably includes many parties who have not previously participated in the Superfund process and who must take time to determine the nature of their liability and the appropriate means for participating in the process.

This site was no exception. Before receipt of the Special Notice Letter, a small nucleus of parties worked to unite a larger number into a cohesive group, but progress was slow. Since receipt of the letter, a site group has been formed and a method for funding the group's activities has been implemented. Because we were not asked to participate in the RI/FS at the site, our efforts in the early months (beginning shortly after receipt of the initial notification from U.S. EPA in December, 1989 that smelter customers had been identified as potentially responsible parties) necessarily focused on simply understanding the history of interaction between NL Industries and Taracorp on one hand, and the U.S. EPA on the other, and obtaining and analyzing technical documents. The group then turned its attention to responding to the Special Notice Letter. While the Special Notice Letter brought a larger number of parties into the fold, a certain amount of time was necessary to apprise those parties that were not familiar with the Superfund program how the system created by the Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA"), 42 U.S.C. § 9601 *et seq.*, functions. Additional time was required for the group to reach consensus regarding what it would be willing to do. Sixty days is not much time for a large group of parties to perform these tasks and reach agreement about serious decisions regarding response activities. While more time would have been fruitful in responding to the agency's request, we have decided not to request it at this juncture because we believe the offer set forth in this correspondence is sufficiently detailed for the agency to continue negotiations with the group with confidence and assurance that a settlement can be reached within the 120-day moratorium period required under CERCLA § 122(e).

III. Summary of the good faith offer.

A. Outline of proposed remedial activities.

We expect that U.S. EPA will focus its attention on the Record of Decision and accompanying Scope of Work to determine which of the tasks we have agreed to perform. We refer you to Exhibit C for our revised Scope of Work. With one exception, we have generally expressed a willingness to perform all the identified tasks. We have discussed that exception below. First, however, we would like to address minor differences. Certain tasks involve improvements to land currently owned by Taracorp and Trust 454 for the benefit of St. Louis Lead Recyclers. For instance, the Scope of Work requires that parties construct a fence around the Taracorp property. Since Taracorp continues to own and operate a business on the property and will receive a benefit from the fence, Taracorp should construct its own fence. Similarly, response activities at the site owned by Trust 454 will directly benefit that property and should be undertaken by the property owners.

We turn then to the area where our offer differs from the Record of Decision and Scope of Work. In its Record of Decision, U.S. EPA requires that the remedial action lower the soil concentration of lead in residential neighborhoods to no greater than 500 ppm. We have proposed a cleanup level of no greater than 1,000 ppm with a lower level to be chosen, if necessary, based on the result of site data gathered specifically to determine the risk, if any, posed by soil lead concentrations.[3] The data we propose to gather is very similar to that U.S. EPA proposed to gather through the tasks set forth in its Record of Decision. To determine the impact of current soil lead levels on the affected population, we propose a health assessment survey as set forth in the modified Scope of Work.

---

[3] We note that the Group has committed to clean to a level of 1,000 even if the study indicates that a higher level is warranted. The Group has decided to offer this cleanup level in the spirit of compromise and in recognition of the fact that the agency will want to follow its guidance when used in combination with appropriate site factors. Whatever the legal status of the agency's guidance under principles of administrative law, a 1,000 ppm level does fall within the range recommended in the guidance. While the guidance also provides the agency with the discretion to set higher levels, we believe that offering a level within the range set in the guidance will help demonstrate our good faith in addressing the cleanup of this site and assuring that the area is rendered safe.

Generally, we propose to identify the population whose blood should be sampled to develop a statistically significant database and collect and analyze the samples. As necessary to correlate blood levels with existing conditions in the nearby environment, the survey would include the collection of soil samples, house dust samples, and other relevant data (for example, the presence of leaded paint) at the homes of children whose blood has been sampled and analyzed. The survey should demonstrate whether lead in soil has created an unacceptable health risk in the area of the Granite City smelter and will provide a means to determine the level of cleanup necessary to eliminate any unacceptable risk.

We further propose that we and the agency use the results of the survey to determine what soil cleanup level is warranted. As noted, we are willing to clean to the upper range of U.S. EPA's guidance document even if the analysis indicates that a higher level may be warranted. The data would be used to determine only whether a cleanup level of less than 1,000 ppm may be appropriate. The reasons for our departure from the Record of Decision are the subject of the attachments to this letter, but we will summarize those reasons in the following overview.

U.S. EPA states in its Record of Decision that its choice of 500 ppm lead concentrations in soil as a trigger for soil cleanup is based on a guidance document and Appendix B to the Record of Decision. Nothing else in the record directly addresses the quantitative relationship between lead soil levels at the Granite City site and potential blood lead levels in the surrounding populace, the recognized indicator of an adverse health impact. We recognize it can be difficult to determine what level of cleanup is appropriate to reduce blood levels. The scientific community has yet to agree on the threshold level for lead and is having difficulty determining what it should be. Worries about the health of children have driven acceptable exposure levels down, and the past few years have seen increasingly stringent requirements for soil cleanup. That risk may exist, however, begs the question of what level of cleanup is appropriate to reduce or eliminate the risk. In light of the recent withdrawal of the reference dose for lead, the agency claims it has been left with little guidance for setting limits. In response, the agency has issued a guidance document stating that the appropriate level for soil cleanup should probably lie within the 500 to 1,000 ppm range.

The guidance specifically states that the entire range is protective in residential soil. It also states that variances from the guidance may be justified in either direction based on site-dependent characteristics, but the guidance is silent about what characteristics should be considered.[4]

Unfortunately, Region V has not used the guidance document as the guidance itself requires. The document does not support the proposition advanced by U.S. EPA both prior to and after the comment period on the proposed Record of Decision that 500 ppm is the preferred level in a residential area. As noted, the guidance document specifically states that the 500 to 1,000 ppm range is considered protective in residential areas. The guidance document has not been superseded. Thus, choosing a level at the lower end of the spectrum simply because the agency is addressing the cleanup of residential soil is inappropriate. The agency discusses the presumed bioavailability of smelter lead as another reason for selecting a value at the lower end of the spectrum, yet the guidance on which the agency's position depends expressly states that the agency has not developed a position on the role bioavailability of lead should play in determining cleanup levels.[5]

U.S. EPA's response to comments regarding the agency's stated reliance on the guidance documents were, to say the least, interesting. Apparently recognizing the weakness of its record,

---

[4] As noted in comments previously submitted to the proposed Record of Decision, the use of a guidance document without consideration of other relevant factors constitutes improper rule making. It is no surprise, then, that OSWER Directive #9355.4-02, Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites, requires U.S. EPA to consider site-specific criteria.

[5] U.S. EPA's claim that the 500 ppm standard is justified by the fact the cleanup standard addresses residential soils differs remarkably from an explanation provided to one of us by an OSWER-Guidance and Oversight Branch representative, who stated that the agency's decisions on choosing a level within the range should be influenced not by whether the standard will address residential soil, but rather by the nature of the neighborhood around the residences. According to that contact, if the neighborhood lies within a broader industrial or inner city area, a higher standard may be appropriate; if in a rural setting, a lower setting may be appropriate. In the present case, the higher standard would be appropriate if one accepts this interpretation of the guidance. Also, the agency's discussion of bioavailability assumes that any measure of bioavailability of the lead at the Granite City site would show that it is high. No such measurement has been conducted.

the agency decided to expand the factors it claimed to rely on in reaching its decision. As the Record of Decision and its appendices specifically indicate, the agency relied on the use of the Integrated Uptake/Biokinetic Model to choose a cleanup level at the low end of the 500 to 1,000 ppm range. We note that the U.S. EPA modeling appended to its Record of Decision was not made available by U.S. EPA during the comment period.

Exhibit B sets forth an extensive critique of U.S. EPA's modeling efforts. The critique explains in detail the usefulness of modeling, as well as its shortcomings where relationships between model parameters are uncertain or relevant data is lacking. In particular, the critique demonstrates that U.S. EPA's choices of default factors (factors which substitute presumed values for site-specific measurements where the latter have not been taken) do not reflect probable conditions at the Granite City site and are not based on applicable data recognized by U.S. EPA. When appropriate values are used, the model's determination of the health impact of soils at 1,000 ppm lead does not exceed, indeed does not come near, those considered detrimental to human health in Appendix B of Attachment I to the Special Notice Letter. Thus, Appendix B does not support the agency's choice of a 500 ppm level.

We have legitimate reasons for focusing on cleanup levels. Congress has mandated that cost-effectiveness be addressed as a factor in remedy selection. 42 U.S.C. § 9621. However, U.S. EPA's analysis did not adequately address cost-effectiveness in its Record of Decision.[6] The agency never considered whether an incremental gain, if any, in health benefits is justified by the increased cost. Discussion of such issues is often relatively difficult since all models which attempt to correlate health effects of lead in soil will probably show that more stringent cleanup levels result in some reduction in blood lead levels. The issue, however, is whether a given reduction in soil levels leads to a perceptible health benefit, not whether a negligible reduction in blood levels will occur whatever the expense. Exhibit B indicates that the marginal

---

[6] U.S. EPA's entire analysis was presented the following single sentence:

> The selected remedy is implementable and provides the elimination of direct contact with and inhalation of soils and waste materials contaminated with lead at concentrations above levels which may present a risk to public health in a comparable or smaller time frame and cost than other alternatives which achieve this goal.

improvement in blood levels traceable to reducing soil lead from 1,000 ppm to 500 ppm is negligible. Exhibit B uses currently accepted data; U.S. EPA in its Record of Decision depends on outdated information for setting default values. Exhibit B also uses data from sites similar to Granite City to calibrate U.S. EPA's model; U.S. EPA's model does not.

Despite the fact that Exhibit B requires the conclusion that a 1,000 ppm level is adequate, we are willing to stake the results of our critique on real data to be gathered through the proposed health survey assessment. In fashioning our offer, we have relied on several statements made by U.S. EPA in its Record of Decision and accompanying documents. We noted that the agency believed the best approach to determine clean up levels was to use the Integrated Uptake/Biokinetic Model and that U.S. EPA had specifically adopted 15μg/dl as the action level for elevated blood lead concentrations. We further noted that the agency considered a distribution in which about 8.4% of the blood lead levels exceeded the action levels to be sufficiently protective of human health and the environment. Finally, we noted that moving the predicted percentage of children with blood lead levels in excess of 15μg/dl from 34.3% to 8.4% (a difference of about 26%) apparently justified, in the agency's judgment, an increase in expense from $6.8 million to $28.5 million (an increase of about $22 million).

In suggesting that a blood lead study be performed, the agency also stated that the study could be used to "determine exactly which areas must excavated and to what depth." Accordingly, U.S. EPA views the model as a useful working tool for determining cleanup levels. We note the guidance document states: "Blood-lead testing should not be used as the sole criterion for evaluating the need for long-term remedial action at sites that do not already have an extensive, long-term blood-lead data base." We do not propose that the blood-lead tests serve as the sole criterion. Rather, the tests are one of several criteria necessary for reaching a final cleanup level, including U.S. EPA's guidance document. Like U.S. EPA's proposal, ours will assure that the chosen cleanup lies within the range recommended by the guidance document irrespective of the outcome of the study and will be protective of human health and the environment.

U.S. EPA expressed concerns in its comments that the continuing presence of lead at the site dictates against further study and in favor of action. U.S. EPA had hoped that the planned blood lead study would be completed in the summer of 1990, but we have learned that the study cannot occur until next year. We are disappointed that the opportunity for conducting the study this year has passed. In any event, our proposal, consistent with the agency's concerns, will move work forward without delay. Many of the tasks required in the Record of Decision would be implemented immediately, and a generic work plan for residential cleanup can be developed now and implemented immediately on completion of the blood-lead study and the analysis of its results. We do not contemplate that the survey will result in substantial delay of the final cleanup. Furthermore, if the survey determines that less cleanup than set forth in the Record of Decision is appropriate, the cleanup schedule will be shorter than originally envisioned. The short-term risks due to disturbance of lead-bearing soils, entrainment into the air, and redeposition in the neighborhood, as well as the considerable risk to local children and other residents from the substantial increase in traffic from earth-moving equipment during the course of remedial activities, will be greatly reduced if cleanup of fewer areas is necessary.

B. Use of the site-specific data to determine a final cleanup level.

The primary problem with using modeling to draw valid conclusions about the appropriate soil cleanup level is the lack of site-specific data which one can use to check assumptions about the health impact of lead in soils in the Granite City area.[7] Our proposal offers a methodology both for determining

[7] This concern is apparently shared by U.S. EPA. In the soil lead cleanup guidance, the agency states:

> In one case, a biokinetic uptake model developed by the Office of Air Quality Planning and Standards was used for a site-specific risk assessment. This approach was reviewed and approved by Headquarters for use at the site, based on the adequacy of data (due to continuing CDC studies conducted over many years). These data included all children's blood-lead levels collected over a period of several years, as well as family socio-economic status, dietary conditions, conditions of homes and extensive environmental lead data, also collected over several years. This amount of data allowed the Agency to use the model without the need for extensive default values. Use of the model thus allowed a more precise calculation of the level of cleanup needed to reduce the risk to children based on the amount of contamination from all sources, and the effect of contamination on blood-lead levels of children.

(continued...)

whether there has been an impact on human health and the environment and for reaching a consensus about an appropriate cleanup level. We accomplish this by performing a health assessment survey to eliminate the shortcomings manifest in U.S. EPA's use of the Integrated Uptake/Biokinetic Model and provide assurance that the factors used in our Exhibit B remain accurate representations of reality in the Granite City area.

We recognize that choosing the appropriate cleanup standard is not easy. However, the offer is without risk to the agency in that it achieves a cleanup within the range suggested by agency guidance. Parties that sign the consent decree are bound at the very least to perform a cleanup. Only data which favors a more stringent cleanup will affect the ultimate decision on the cleanup level. Our methodology will permit a cost-effective remedy protective of human health and the environment to be selected from the 500 to 1,000 ppm range.

To set a cleanup level, we would use the blood lead data in the following manner. First, we would determine what portion of the target population exhibited blood lead levels in excess of 15 µg/dl. If the percentage was 8.4% or less, we would assume that U.S. EPA's performance criteria for blood lead levels have been met and perform the cleanup to the 1,000 ppm level. If the percentage exceeded 8.4%, we would then use various linear regression tools and additional environmental assessment data to determine the appropriate cleanup. The first step in the determination would consist of using multiple linear regressions based on the data gathered in the health assessment survey to determine which environmental lead sources are the major contributors to blood lead. Then, a regression analysis would be performed to determine the relationship between soil lead and blood lead. To provide U.S. EPA with data to evaluate our result in light of the agency's Record of Decision, we also propose to confirm the results using the Integrated Uptake/Biokinetic Model (substituting real data values for default factors) and compare the results with those obtained through the linear regression analyses.

Our proposal for confirming the regression analyses by using the Integrated Uptake/Biokinetic Model requires agreement

---

7 (...continued)

The study we propose will collect the data necessary to reduce dependence on default values, the type of dependence which led the agency astray in its use of the model for the Granite City area.

on the factors to be inserted in the model. As noted in Exhibit B, U.S. EPA used values with which we take issue. We assume that we and U.S. EPA can reach agreement on the appropriate values to be inserted in the model based on analysis of the health assessment survey data.

We also propose a factor to take into account that our study may demonstrate that a significant portion of the lead likely to be ingested in the area will not originate from the soil. As Exhibit B notes, for example, U.S. EPA failed to take into account other significant sources like paint. We cannot control other sources and should not be required to address contamination unrelated to the smelter itself, in particular, where other fixes would be considerably more cost-effective or will occur in the natural course of time. If lead paint, for example, is the major cause of the problem, the best solution is to address the paint. We are not wedded to any particular factor as long as the factor finally chosen fairly reflects the contribution of soil lead to blood lead levels and the health benefit to be gained by performing cleanup to a particular level.

To choose a factor which recognizes the multiple sources of lead, we propose the following methodology. The studies we perform will allow us to calculate the percentage of total blood lead levels resulting from soil lead. Historical data providing the range of blood lead levels implicit in the Integrated Uptake/Biokinetic Model provides a mechanism to determine what percentage of blood lead levels lie above a chosen standard, as demonstrated by U.S. EPA's use of the model in its Record of Decision. We would accept a cleanup level which reduces that fraction of the excess over the target level for which soil is responsible. This suggested soil lead factor would explicitly take into account what U.S. EPA presumed in its analysis. The agency stated that an 8.4% rate of excess blood levels was appropriate since the agency expected that contributions of other lead sources would also decrease. Our methodology would provide an objective standard by which to measure the relative contribution of each source. Once we have obtained the appropriate cleanup level, we will compare it to U.S. EPA's guidance document. If the lead level is above 1,000 ppm, we will nevertheless clean the soils to the 1,000 ppm level. If the level is below 1,000 ppm, we will clean to the calculated level or to 500 ppm, whichever is greater.

In summary, we believe our proposal specifically addresses all of the major concerns U.S. EPA raised in its comments to its Record of Decision regarding use of soil cleanup levels exceeding 500 ppm and provides a scientifically justifiable basis for setting a cleanup level without delay and in a manner which protects human health and the environment. We are willing to negotiate with U.S. EPA a consent decree which will embody these principles.

C. **Financial willingness and ability to perform.**

By making this offer, we express a willingness to perform the RD/RA as we have proposed. Regarding the financial ability of the parties to this offer to finance the RD/RA, the parties include among their number major corporations listed on national stock exchanges. Annual reports or other security filings for these companies will be made available on request. The group also includes smaller companies which are not capable of financing the offer without the cooperation of the parties referenced above. In light of the involvement of other large corporations, however, this factor should not affect performance of the remedy. Also, we note the Consent Decree proposes financial security.

D. **Selection of a contractor.**

While many of us have staffs capable of conducting portions of the RD/RA, we intend to vest control of site activities in the hands of a competent environmental consultant who would be commissioned to undertake the proposed RD/RA in conjunction with other contractors suggested by the consultant and approved by us. The protocol we propose for selecting the consultant, which has been used by some of us at another lead smelter site, is as follows:

- Use a pre-bid qualification procedure to create a list of contractors to whom bid packages will be forwarded:
    - Determine which contractors have experience with RD/RAs for lead smelter sites or other sites where lead is present
    - Consider the industry reputation of contractors capable of performing the RD/RA
    - Consider specific recommendations from former and current clients of prospective contractors
- Submit bid packages to listed contractors soliciting information on the following:

- Costs for individual tasks
- A schedule for completion of the tasks
- Qualifications to perform the RD/RA
- Resumes for the team assigned to the RD/RA
- Review the bids according to a predetermined evaluation plan and select a contractor
- Obtain any necessary agency approval

IV. Matters which the parties to this offer have not had the opportunity to adequately address.

Several collateral issues are suggested by the attachments to the Record of Decision apart from concerns about the extent of the remedy. Given the tight schedule to consider central issues, we have not had the opportunity to fully conside the following matters.

A. De Minimis parties.

We have addressed issues which normally arise with respect to de minimis parties pursuant to 42 U.S.C. § 9622(g), such as the parameters for inclusion in a de minimis subgroup an premiums for releases. A subcommittee has been formed to finalize a plan and options are being considered. We believe an acceptable arrangement can be reached within the time frame of negotiating a final consent decree. We note, however, that only a fraction of entities likely to be included within the category have joined our group to date. Accordingly, it will be difficul to determine the likely success of our efforts until an offer is disseminated and considered by interested parties.

B. Agency allocation.

We have not yet addressed two concerns regarding allocation among those identified by U.S. EPA as potentially responsible parties. The first issue concerns allocation of costs between the site owner/operators and their former customers. The offer remains contingent on an interim settlement. Nevertheless, we are confident that the parties can reach at the very least an interim funding agreement reasonable under the circumstances which will permit all parties to cooperate in remedial activities at the site pursuant to a consent decree.

The second issue concerns the allocation assigned by U.S. EPA for smelter customers and vendors. Because the partie have been focusing their efforts on organizing and reaching consensus on a good faith offer, they have not had the time or opportunity to review the documentation on which U.S. EPA's customer list is based. Accordingly, this offer is also contingent on these parties reaching agreement on appropriate allocation of costs. In this context there are a number of issues to consider. We note that the documents examined by U.S EPA or its contractors cover a relatively insubstantial period time during which the smelter operated. Thus, the documents do not take into account all customers or vendors which may have used the site, and the percentages reflect only the relative us of the site by customers or vendors during the period covered b the documents, and then only to the extent that the documents a complete for that period. It may be necessary for the agency t notify other parties of their potential liability if they are identified as using the site at periods for which documents do not exist. Furthermore, many of the customers and vendors currently identified by U.S. EPA as potentially responsible parties were not customers or vendors for many years during whi it operated. Accordingly, any percentage scheme may have to be adjusted to account for the potential inequity of extrapolating to years for which records are not available.

We have formed an allocation committee which has begu work to address these issues. With appropriate cooperation on the part of the agency in obtaining copies of documents, we believe our tasks can be completed in a timely matter as necessary to fashion a Consent Decree.

V. Conclusion.

U.S. EPA has requested that parties making an offer provide a contact person for future negotiations. We have created a team for negotiations and request that you channel al contacts regarding the site to counsel for Johnson Controls, Inc.:

Dennis P. Reis, Esq.
Sidley & Austin
One First National Plaza
Suite 5400
Chicago, IL 60603
(312) 853-2659

GC 106942

We look forward to your cooperation in reaching a good faith settlement.

Yours very truly,

Dennis P. Reis

DPR:jdt

Enclosures

cc: Steven Siegel
Parties listed on Exhibit A
Site PRP Group

good candidate for use in predicting the reductions in the blood lead concentration of children living near lead point sources that will result from specified reductions in air, soil/dust or dietary lead exposure.

When actual data for the four sites are applied in the model, the results indicate that air lead concentrations are a minor contributor to blood lead concentrations. The percentage of total exposure which is represented by the inhalation pathway ranges from 0.2% at Kellogg, 4.0% at Toronto, 5.2% at Herculaneum to 8.6% at Helena. These percentages reflect the contribution due to lead in ambient air relative to the total exposure to lead from all pathways. Thus, the percentage will increase as air concentrations increase; but the percentage will decrease when exposures from other pathways increase. Once the 1.5 $\mu g/m^3$ standard is attained at each site the maximum percentage contribution from inhalation would be 3.5%.

For the sites included in this study, the model predicts that reductions of 1 $\mu g/m^3$ in ambient air lead concentrations (the maximum reduction in the standard proposed by the EPA) would yield reductions in blood lead concentrations of an average of 0.34 $\mu g/dl$ (range 0.2 to 0.5 $\mu g/dl$).

In short, EPA's uptake/biokinetic model, as adjusted and evaluated in this study, shows that a reduction of the National Ambient Air Quality Standard for lead from the present 1.5 $\mu g/m^3$ concentration would have no meaningful effect on children's blood lead concentrations. The model also shows that soil and house dust are far and away the dominant influence on children's blood concentrations at the four sites.

GC 106944

TABLE OF CONTENTS

GC 106945

TRC

LIST OF FIGURES

LIST OF TABLES

GC 106946

TRC

day by two year old children. Table 1 presents the T, C_i, and A_i values used in the evaluation. In addition, Table 1 indicates qualitatively the level of confidence associated with each of the T, C_i, and A_i values.

To apply the uptake/biokinetic model to a specific site, a set of environmental lead concentrations $[Pb]_i$ must be defined for that site. The four environmental concentrations which make up the set of $[Pb]_i$ required by the model include: 1) Outdoor air lead ($\mu g/m^3$); 2) Indoor air lead ($\mu g/m^3$); 3) Street dust/soil lead (ppm); and 4) Indoor dust lead (ppm). Outdoor air lead and soil/street dust lead were measured at all of the sites included in this evaluation. Some of the sites had indoor dust lead measurements while none of the sites had data on indoor air lead. For this evaluation, indoor air lead was estimated as 0.3 times outdoor air lead as was done by EPA.[1] Additionally, where no indoor dust measurements were readily available, the indoor dust lead concentration was assumed to be equivalent to the outdoor concentration. Appendix A describes the ambient lead concentration data which were available for the five study data sets.

GC 106949

TRC

TABLE 1

TRANSFORMATION, ABSORPTION, AND CONSUMPTION PARAMETERS USED IN THE MODEL EVALUATIONS

Parameter	EPA Provided Values Range	Quality
C.		
Time Spent Outdoors (hrs/day)	2-4	Good
Volume of Air Respired (m^3/day)	4-5	Good
Natural Lead, Indirect Atmospheric (µg/day)	2.4	Fair
Lead from Solder (µg/day)	10.0	Fair
Lead from Drinking Water(µg/day)	1.2	Poor
Atmospheric Lead Ingested With Food (µg/day)	10.3	Fair
Lead from Undetermined Sources Ingested With Food (mg/day)	1.2	Fair
Amount of Dirt/Dust Ingested (mg/day)	100*	Poor
A_i		
Deposition/Absorption in Lungs (%)	35-60**	Fair
Absorption in Gut (%)	42-53	Good
Dirt Lead Absorption (%)	30	Good
T		
Transformation of Lead Uptake to Blood Lead (µg/dl/µg/day)	0.4	Good

* In December 1986, EPA was suggesting that this value be increased to 200 mg/day.

** In December 1986, EPA was suggesting that this value's range be increased to 45-75%

GC 106950

TRC

3.0 MODEL EVALUATION

The first step in the evaluation was applying the uptake/biokinetic model using the EPA provided default values for T_i A_i and C_i (Table 1). The measured data sets for each of the four sites are described in Appendix A. The results of applying the model to the East Helena data are presented in Figure 1 as an example. There are two features exhibited in Figure 1 which were found consistently among the different sites when the EPA default values were used: 1) the model overpredicted observed blood lead; and 2) dirt ingestion contributed a large majority of the lead uptake.

Next, the above test was repeated using 200 µg/day for amount of dirt ingested and 45-75% absorption in the lungs as suggested by EPA in December, 1986. The results of using 100 mg/day and 200 mg/day for amount of dirt ingested are compared in Figure 2. A 1:1 ratio line for perfect correlation has been added to Figure 2 for ease of reference. From Figure 2 it can be seen that the overprediction was worse when the 200 mg/day value was used. Neither value provided acceptable predictions of observed blood lead concentrations.

To alleviate this deficiency, the model was re-examined to determine if any justifiable changes could be made to improve performance. Three areas for possible adjustment were noted: 1) percent deposition/absorption in lungs; 2) daily amount of dirt/dust ingested; and 3) dietary lead consumption. The first two were identified as candidates for changes on the basis that both were changed by EPA and therefore, presumably are the values in which EPA has the least confidence. The dietary lead consumption category was selected due to the relative scarcity of data on this subject in the recent EPA draft staff paper.[1] However, adjustment of the dietary lead consumption was not considered further because of its relatively small impact on total lead uptake. Consideration of percent lead absorbed in lungs also was abandoned

EPA's Integrated Lead Uptake/Biokinetic Model   Date: 4/20/87   Analyst: [illegible]
Site: East Helena, Montana

	AREA 1 Low	AREA 1 Mean	AREA 1 High	AREA 2 Low	AREA 2 Mean	AREA 2 High	AREA 3 Low	AREA 3 Mean	AREA 3 High
1. Outdoor air lead (ug/m3)	2.96	3.87	4.79	0.20	1.10	2.00	0.21	0.21	0.21
2. Indoor air lead (ug/m3)	0.89	1.16	1.44	0.00	0.30	0.60	0.06	0.06	0.06
3. Time spent outdoors (hours/day)	2.00	3.00	4.00	2.00	3.00	4.00	2.00	3.00	4.00
4. Time weighted average (ug/m3)	1.06	1.50	2.00	0.10	0.44	0.85	0.08	0.08	0.09
5. Volume of air respired (m3/day)	4.00	4.50	5.00	4.00	4.50	5.00	4.00	4.50	5.00
6. Lead intake from air (ug/day)	4.24	6.75	9.90	0.40	1.99	4.17	0.30	0.37	0.44
7. % deposition/absorption in lungs	35.00	40.00	60.00	35.00	40.00	60.00	35.00	40.00	60.00
8. Total lead uptake from lungs (ug/day)	1.5	2.7	6.0	0.1	0.8	2.5	0.1	0.2	0.3
9. Dietary lead Consumption (ug/day)									
a) natural lead, indirect atmosphere	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
b) from solder or other metals	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
c) drinking water	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
d) atmospheric lead	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
e) undetermined sources	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
10. % absorption in gut	42.00	40.00	33.00	42.00	40.00	33.00	42.00	40.00	33.00
11. Dietary lead uptake (ug/day)	9	10	11	9	10	11	9	10	11
12. Street dust/soil lead (ug/g)	81	720	3410	50	217	1252	54	86	237
13. Indoor dust lead (ug/g)	290	1500	10361	119	541	2651	80	300	1331
14. Time weighted average (ug/g)	210	1371	13379	109	475	2105	76	307	900
15. Amount of dirt ingested (g/day)	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
16. Lead intake from dirt (ug/day)	21	137	1338	11	48	210	8	31	90
17. % dirt lead absorption in gut	30	30	30	30	30	30	30	30	30
18. Lead uptake from dirt (ug/day)	6	41	401	3	14	64	2	9	29
19. Total lead uptake from lung and gut (ug/day)	17	54	410	12	25	79	11	19	41
20. % lead uptake from lungs	9.0	6.0	1.4	1.2	3.8	3.2	1.0	0.9	0.6
21. % lead uptake from diet	52.3	18.2	2.6	71.0	39.4	13.0	78.5	51.3	26.9
22. % lead uptake from dirt	38.7	75.8	96.0	27.1	56.8	83.8	20.6	47.7	72.4
23. Predicted Blood Lead	7	22	167	3	10	32	4	8	16
24. Observed Blood Lead	3.0	14.0	33.0	1.0	10.0	20.0	2.0	7.0	17.0
25. Ratio Predicted:Observed Blood Lead	2.2	1.6	5.1	4.0	1.0	1.3	2.2	1.1	1.0
26. Number of children tested	22.00	22.00	22.00	37.00	37.00	37.00	16.00	16.00	16.00

GC 106952

TRC

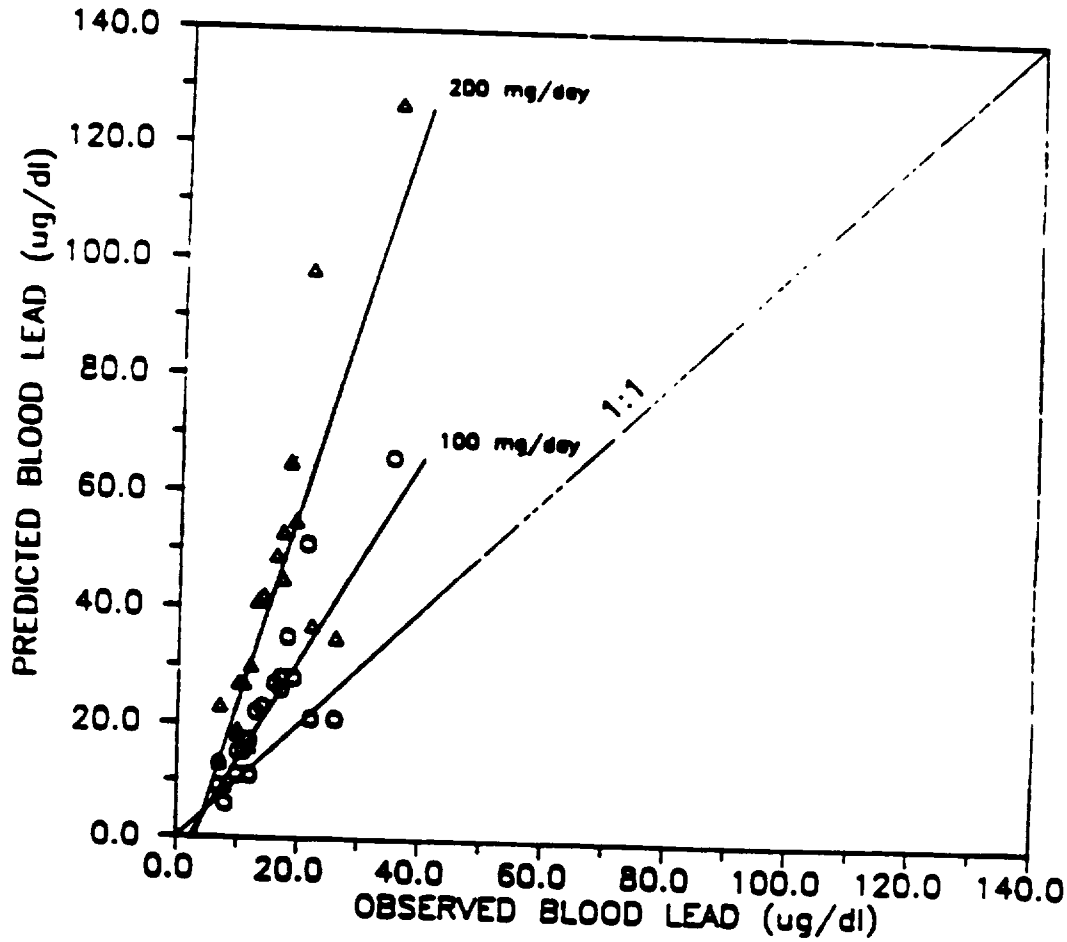


Figure 2 Uptake/Biokinetic Model Performance using February, 1986 and December, 1986 Default Values

GC 106953

because of the small impact on total lead uptake and the minor change suggested by EPA in December, 1986 indicating it was fairly well established. Daily dirt ingestion therefore became the focus of model adjustment activities.

The amount of dirt eaten per day by the typical two year old child was a good candidate for adjustment because 1) it had a large impact on total lead uptake; and 2) there is little information on the amount of dirt a child eats in the normal course of a day. An attempt was made in the East Helena study to estimate the amount of dirt eaten per day by the typical child,[3] but the authors of that study present the results as very preliminary. In addition, it seems reasonable that the distribution associated with daily dirt ingestion might be broader than that associated with some of the other parameters such as daily volume of air respired.

To evaluate the performance improvements obtainable by adjusting the dirt ingestion rate, two daily dirt ingestion amounts were proposed and tested. The proposed daily dirt ingestion amounts were 60 mg/day and 50 mg/day, respectively. Both proposed ingestion rates provided excellent model performance. For example, Figure 3 presents the results of using 60 mg/day with the East Helena data, which, when compared with Figure 1 (100 mg/day), demonstrates the superior model performance associated with the reduced ingestion rates. The magnitude of the improvement provided by the proposed rates is strikingly apparent in Figure 4 which compares the four evaluated ingestion rates (50, 60, 100 and 200 mg/day). In addition, Figure 4 indicates that 60 mg may be a somewhat better value (slightly overpredicting but same correlation coefficient) for the amount of dirt ingested by a typical child during a normal day. Therefore, 60 mg/day was established as the optimized daily dirt ingestion rate.

The next step was conducting a sensitivity analysis to determine if any parameters other than the dirt ingestion rate had a large influence on the predictive ability of the optimized uptake/biokinetic model. The three

EPA - Integrated Lead Uptake/Biokinetic Model Date: 4/24/87 Analyst: RID
Site: East Helena, Montana

	AREA 1 Low	Mean	High	AREA 2 Low	Mean	High	AREA 3 Low	Mean	High
1. Outdoor air lead (ug/m3)	2.96	3.07	4.79	0.70	1.10	2.00	0.71	0.71	0.71
2. Indoor air lead (ug/m3)	0.89	1.16	1.40	0.00	0.34	0.60	0.06	0.06	0.06
3. Time spent outdoors (hours/day)	2.00	3.00	4.00	2.00	3.00	4.00	2.00	3.00	4.00
4. Time weighted average (ug/m3)	1.06	1.50	2.00	0.10	0.40	0.83	0.00	0.00	0.09
5. Volume of air required (m3/day)	4.00	4.50	5.00	4.00	4.50	5.00	4.00	4.50	5.00
6. Lead intake from air (ug/day)	4.20	6.75	9.90	0.40	1.99	4.17	0.30	0.37	0.44
7. % deposition/absorption in lungs	35.00	40.00	60.00	35.00	40.00	60.00	35.00	40.00	60.00
8. Total lead uptake from lungs (ug/day)	1.5	3.2	6.0	0.1	1.0	2.5	0.1	0.2	0.3
9. Dietary lead consumption (ug/day)									
a) natural food, indirect atmosphere	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
b) from solder or other metals	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
c) drinking water	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
d) atmospheric lead	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
e) undetermined sources	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
10. % absorption in gut	42.00	40.00	33.00	42.00	40.00	33.00	42.00	40.00	33.00
11. Dietary lead uptake (ug/day)	9	10	11	9	10	11	9	10	11
12. Street dust/soil lead (ug/g)	81	720	3016	50	217	1232	54	86	237
13. Indoor dust lead (ug/g)	290	1500	10361	119	561	2630	80	300	1331
14. Time weighted average (ug/g)	210	1371	13379	109	475	2105	76	307	900
15. Amount of dirt ingested (g/day)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
16. Lead intake from dirt (ug/day)	13	82	803	7	29	131	5	18	59
17. % dirt lead absorption in gut	30	30	30	30	30	30	30	30	30
18. Lead uptake from dirt (ug/day)	4	25	201	2	9	39	1	6	18
19. Total lead uptake from lung and gut (ug/day)	14	38	250	11	19	53	10	16	29
20. % lead uptake from lungs	10.6	8.6	2.3	1.3	4.9	4.7	1.0	1.1	0.9
21. % lead uptake from diet	61.9	26.2	4.2	80.5	50.0	20.7	85.5	63.5	37.9
22. % lead uptake from dirt	27.5	65.1	93.4	18.2	44.1	74.6	13.5	35.4	61.2
23. Predicted Blood Lead	6	13	103	4	8	21	4	6	12
24. Observed Blood Lead	3.0	14.0	33.0	1.0	10.0	24.0	2.0	7.0	17.0
25. Ratio Predicted:Observed Blood Lead	1.9	1.1	3.1	4.3	0.8	0.9	2.0	0.9	0.7
26. Number of children tested	22.00	22.00	22.00	37.00	37.00	37.00	16.00	16.00	16.00

GC 106955

TRC

Figure 3. Example Output of the Optimized Uptake/Biokinetic Model

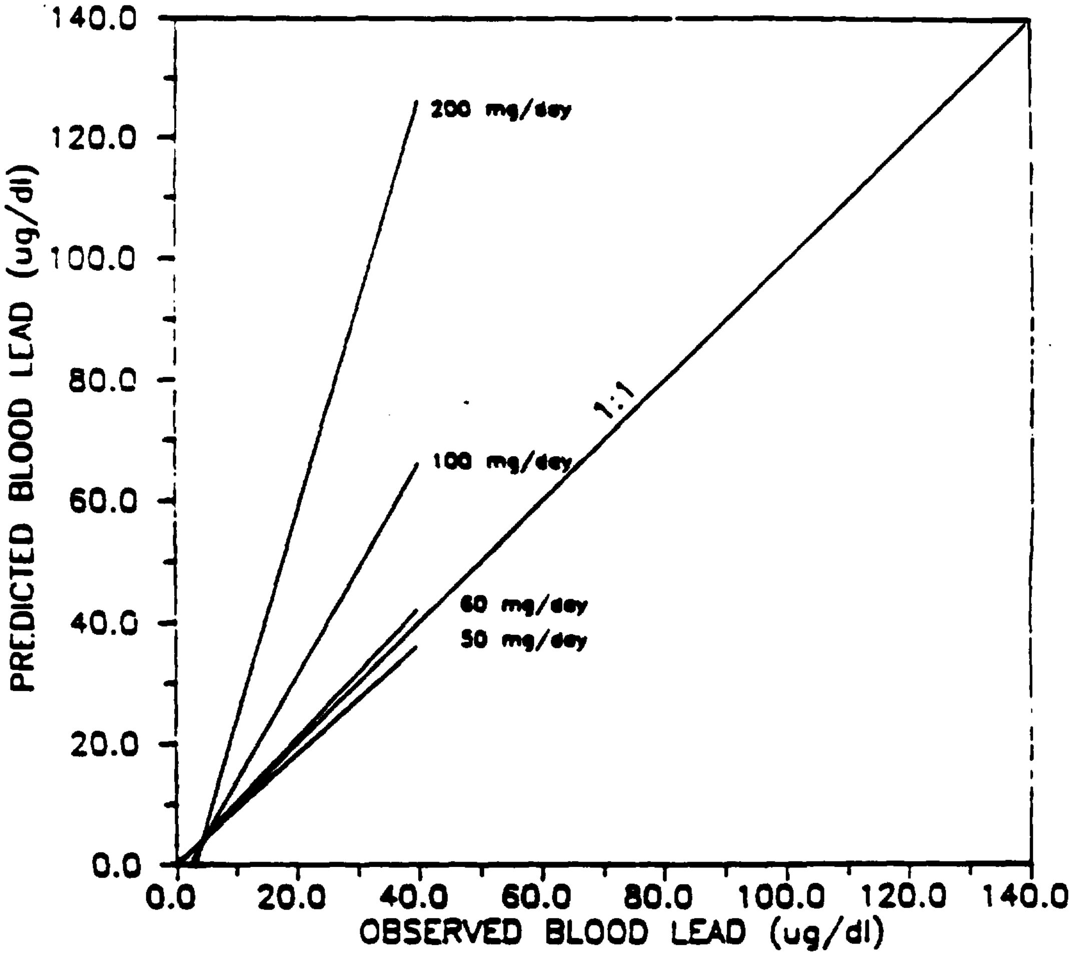


Figure 4 Effect of Dirt Ingestion Rate on Uptake/Biokinetic Model Performance

GC 106956

TRC

parameters selected for investigation in the sensitivity analysis were: 1) total lead uptake from inhalation, 2) lead uptake due to dietary sources other than drinking water and 3) lead uptake from drinking water. The sensitivity analysis was performed by varying the parameters of interest by +100% and -50%. Figures 5, 6 and 7 show the sensitivity analysis results related to lead uptake from inhalation, dietary sources other than drinking water and drinking water, respectively. Figure 5 demonstrates that the relative role of the inhalation pathway is small for the four test sites. Figure 6 indicates that dietary sources have a somewhat larger impact on model performance. However, of the three sets of dietary parameters which were evaluated, the default set provided the best results. Therefore, there was no need to investigate the possibility of adjusting the dietary parameters. Figure 7 demonstrates that drinking water at the EPA chosen concentration of 0.6 μg/liter, which is well below the drinking water standard, is a negligible exposure pathway with respect to influencing children's blood lead concentrations. East Helena was the only site at which measures of lead in drinking water were attempted. The results were less than 0.005 μg/liter. Higher drinking water concentrations of lead caused by leaded piping could make larger percentage contributions to blood lead concentrations in specific children. Similarly, lead paint if present could provide high concentrations and skew the averages used in these model runs. No further changes were made to the optimized uptake/biokinetic model as a result of the sensitivity analysis.

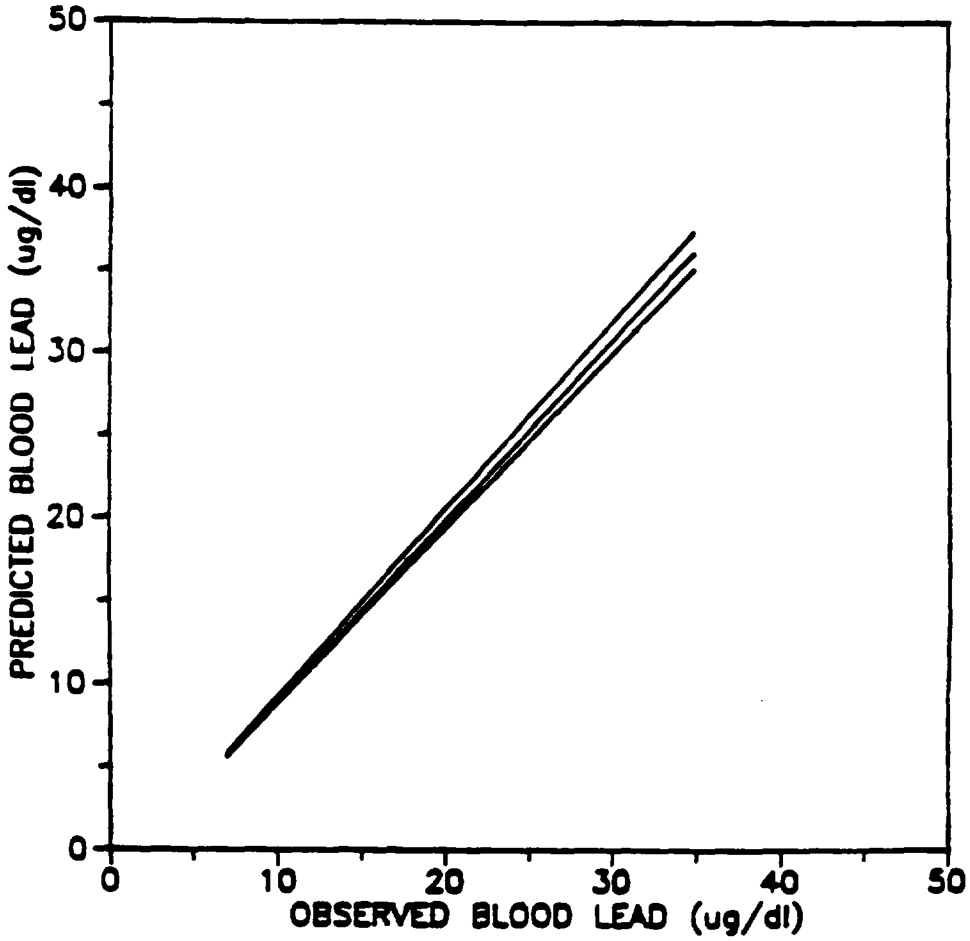


Figure 5: Sensitivity of the Optimized Uptake/Biokinetic Model to total lead uptake via inhalation. The top line refers to the default daily respiration volume multiplied by 2, the center line refers to the default daily respiration volume and the bottom line refers to the default daily respiration volume divided by 2.

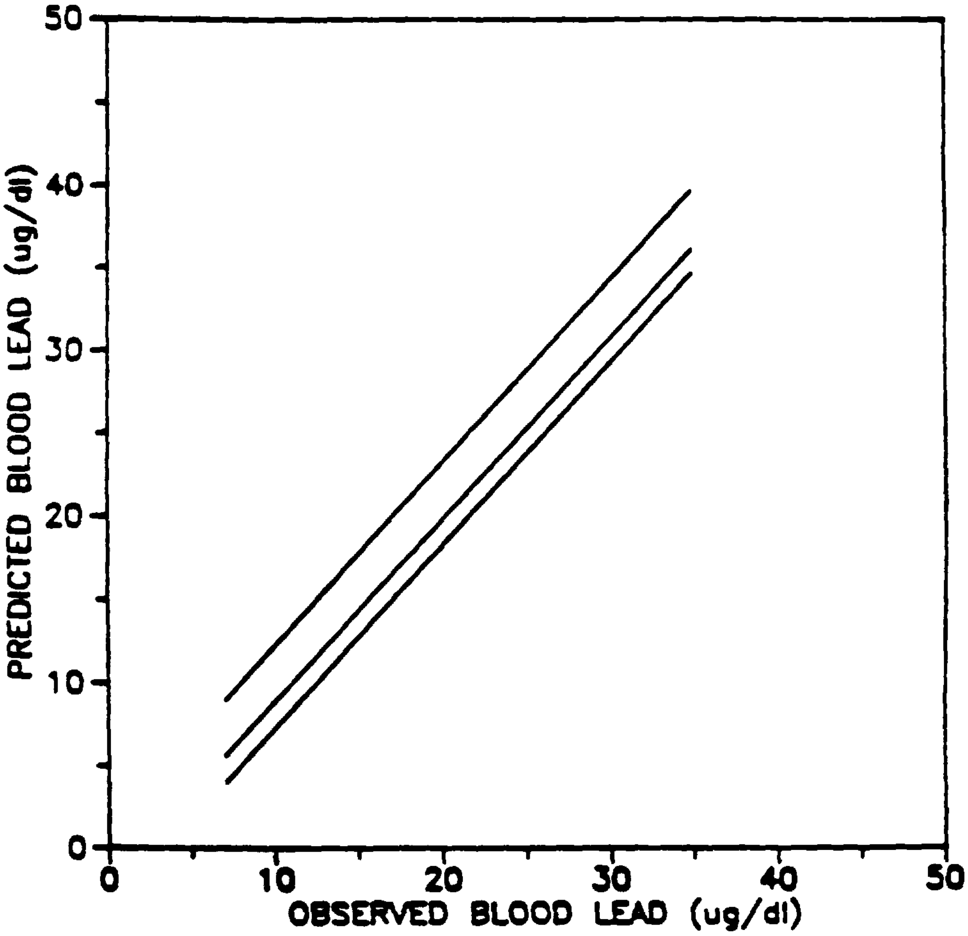


Figure 6: Sensitivity of the Optimal Uptake/Biokinetic Model to dietary sources other than drinking water. Fore the top line the default values are multiplied by 2, for the center line the default values are used and for the bottom line the default values were divided by two.

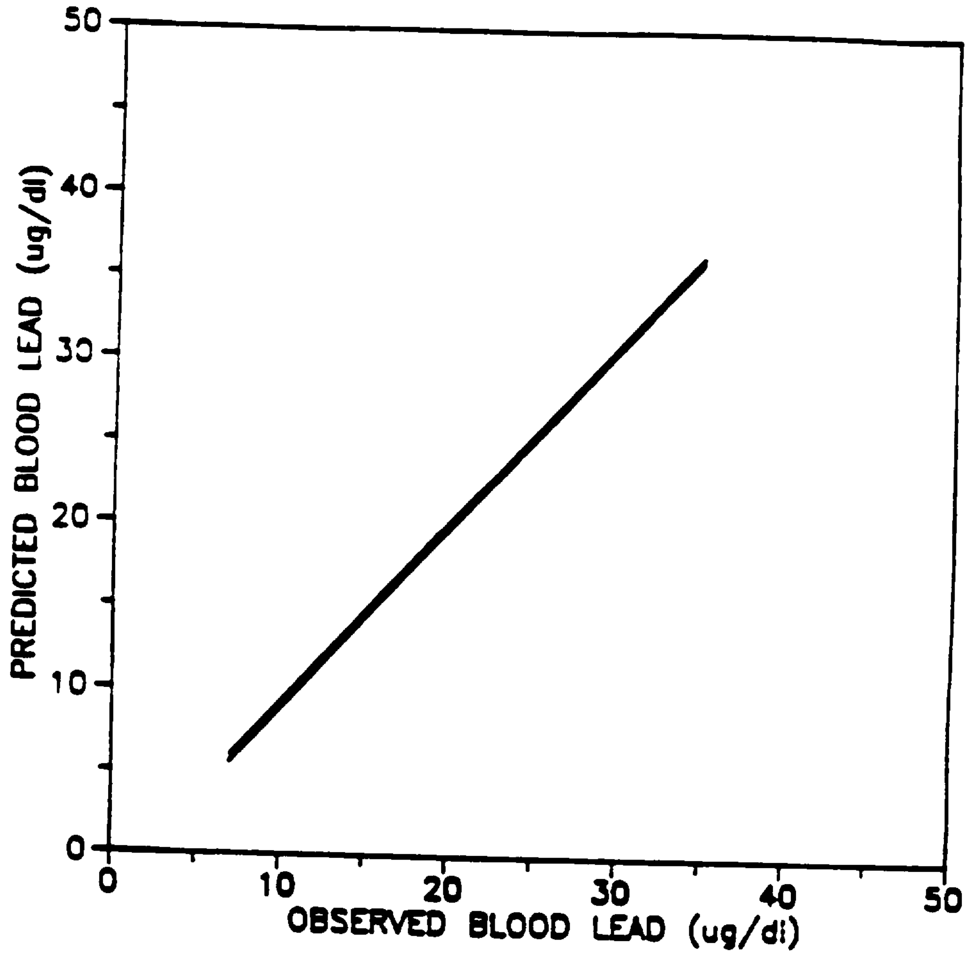


Figure 7: Sensitivity of the Optimized Uptake/Biokinetic Model to drinking water related lead uptake. For the analysis, the default drinking water value was varied by +100% and -50%. The effect of these changes were negligible making the three lines indistinguishable.

4.0 DISCUSSION OF THE RESULTS

Figures 8-12 summarize the results of adjusted modeling efforts for each of the four sites. Each of the tables shows how lead uptake from three pathways -- inhalation, diet, and soil and house dust - was calculated at each smelter site. Separate areas of increasing distance from the smelters were defined, and separate calculations were made for each such area. The figures also provide separate model calculations for low, mean and high. The range represented is both the range in measured data and the range of assumptions (see Figure 1). The low, therefore, represents every measurement and variable at the low end and similarly for the high. These lows and highs can be compared with the range of observed blood lead concentrations where available but a much more useful comparison is the mean predicted versus mean observed. For Herculaneum the range of predicted values is small and only the highs and lows are presented.

For Toronto, both the 1973-1974 data and the 1984-1985 data have been modeled and are presented in Figures 10 and 11, respectively. For consistency, where blood lead concentrations for 2 year olds were differentiated, only 2 year olds were used. A review of the age differentiated measurements show no striking differences among age groups.

For each area, children's blood lead concentrations predicted by the model are compared to actual, observed blood lead measurements of children living in the area. The mean predicted and mean observed blood lead concentrations were strikingly close at three of the four sites and acceptably close at the fourth, Kellogg, as the following table shows.

GC 106961

EPA - Integrated Lead Uptake/Biokinetic Model   Date: 4/20/87   Analyst: PIP
Site: East Helena, Montana

	AREA 1 Low	AREA 1 Mean	AREA 1 High	AREA 2 Low	AREA 2 Mean	AREA 2 High	AREA 3 Low	AREA 3 Mean	AREA 3 High
1. Outdoor air lead (ug/m3)	2.96	3.07	4.79	0.20	1.10	2.00	0.21	0.21	0.21
2. Indoor air lead (ug/m3)	0.89	1.16	1.40	0.08	0.30	0.60	0.06	0.06	0.06
3. Time spent outdoors (hours/day)	2.00	3.00	4.00	2.00	3.00	4.00	2.00	3.00	4.00
4. Time weighted average (ug/m3)	1.06	1.50	2.00	0.10	0.44	0.83	0.08	0.08	0.09
5. Volume of air respired (m3/day)	4.00	4.50	5.00	4.00	4.50	5.00	4.00	4.50	5.00
6. Lead intake from air (ug/day)	4.24	6.75	9.98	0.40	1.99	4.17	0.30	0.37	0.44
7. % deposition/absorption in lungs	25.00	40.00	60.00	25.00	40.00	60.00	25.00	40.00	60.00
8. Total lead uptake from lungs (ug/day)	1.3	3.2	6.0	0.1	1.0	2.5	0.1	0.2	0.3
9. Dietary lead Consumption (ug/day)									
a) natural lead, indirect atmosphere	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40
b) from solder or other metals	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
c) drinking water	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
d) atmospheric lead	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
e) undetermined sources	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
10. % absorption in gut	42.00	48.00	53.00	42.00	48.00	53.00	42.00	48.00	53.00
11. Dietary lead uptake (ug/day)	9	10	11	9	10	11	9	10	11
12. Street dust/soil lead (ug/g)	81	720	3016	38	217	1232	34	86	237
13. Indoor dust lead (ug/g)	200	1500	18561	119	361	2631	80	300	1338
14. Time weighted average (ug/g)	216	1371	13319	109	475	2105	76	307	900
15. Amount of dirt ingested (g/day)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
16. Lead intake from dirt (ug/day)	13	82	803	7	29	138	5	18	59
17. % dirt lead absorption in gut	30	30	30	30	30	30	30	30	30
18. Lead uptake from dirt (ug/day)	4	25	241	2	9	39	1	6	18
19. Total lead uptake from lung and gut (ug/day)	16	38	250	11	19	53	10	16	29
20. % lead uptake from lungs	10.6	8.6	2.5	1.3	4.9	4.7	1.0	1.1	0.9
21. % lead uptake from diet	61.9	26.2	4.2	80.5	51.0	20.7	85.5	63.5	37.9
22. % lead uptake from dirt	27.5	65.3	93.4	18.2	44.1	74.6	13.5	35.4	61.2
23. Predicted Blood Lead	6	13	103	4	8	21	4	6	12
24. Observed Blood Lead	3.0	14.0	33.0	1.0	10.0	24.0	2.0	7.0	17.0
25. Ratio Predicted:Observed Blood Lead	1.9	1.1	3.1	4.3	0.8	0.9	2.0	0.9	0.7
26. Number of children tested	22.00	22.00	22.00	57.00	57.00	57.00	16.00	16.00	16.00

Figure 8. East Helena

TRC

Herculaneum Blood Lead Study-1984 data   Date: 5/26/87

Sector-miles from plant stack	Pevely N-NW 0.0-0.5		N NW 0.5-1.0		N-NW 1.0-1.5		NW N 0.0-0.5		NW-N 0.5-1.0		N SW 0.0-0.5	
1. Outdoor air lead (ug/m3)	2.0	2.0	1.1	1.1	0.8	0.8	2.2	2.2	0.8	0.8	0.8	0.8
2. Indoor air lead (ug/m3)	0.8	0.8	0.3	0.3	0.2	0.2	0.7	0.7	0.2	0.2	0.2	0.2
3. Time spent outdoors (hours/day)	2.0	4.0	2.0	4.0	2.0	4.0	2.0	4.0	2.0	4.0	2.0	4.0
4. Time weighted average (ug/m3)	1.00	1.17	0.39	0.46	0.29	0.33	0.79	0.92	0.29	0.33	0.29	0.33
5. Volume of air respired (m3/day)	4.0	5.0	4.0	5.0	4.0	5.0	4.0	5.0	4.0	5.0	4.0	5.0
6. Lead intake from air (ug/day)	4.00	5.83	1.58	2.29	1.15	1.67	3.15	4.58	1.15	1.67	1.15	1.67
7. % deposition/absorption in lungs	35.0	60.0	35.0	60.0	35.0	60.0	35.0	60.0	35.0	60.0	35.0	60.0
8. Total lead uptake from lungs (ug/day)	1.4	3.5	0.6	1.4	0.4	1.0	1.1	2.8	0.4	1.0	0.4	1.0
9. Dietary lead Consumption (ug/day)												
a) natural lead, indirect atmosphere	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
b) from solder or other metals	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
c) drinking water	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
d) atmospheric lead	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
e) undetermined sources	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
10. % absorption in gut	42.0	53.0	42.0	53.0	42.0	53.0	42.0	53.0	42.0	53.0	42.0	53.0
11. Dietary lead uptake (ug/day)	8	10	8	10	8	10	8	10	8	10	8	10
12. Street dust/soil lead (ug/g)	1450	1450	827	827	100	100	2330	2330	500	500	2239	2239
13. Indoor dust lead (ug/g)	2000	2000	1600	1600	630	630	1610	1610	975	975	1210	1210
14. Time weighted average (ug/g)	1976	1873	1471	1302	550	469	1760	1926	897	819	1382	1553
15. Amount of dirt ingested (g/day)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
16. Lead intake from dirt (ug/day)	119	112	88	84	33	28	106	116	54	49	83	93
17. % dirt lead absorption in gut	30	30	30	30	30	30	30	30	30	30	30	30
18. Lead uptake from dirt (ug/day)	36	34	26	29	10	8	32	35	16	15	25	28
19. Total lead uptake from lung and gut (ug/day)	45	47	35	36	18	20	41	47	25	26	33	39
20. % lead uptake from lungs	3.1	7.4	1.6	3.9	2.2	5.1	2.7	5.8	1.6	3.9	1.2	2.6
21. % lead uptake from diet	17.7	21.3	22.8	28.3	43.7	51.6	19.5	21.2	32.3	39.0	24.0	25.8
22. % lead uptake from dirt	79.1	71.3	75.6	67.9	54.1	43.3	77.8	73.0	65.8	57.1	74.8	71.6
23. Predicted Blood Lead	18	19	14	14	7	8	16	19	10	10	13	16
24. Observed Blood Lead	19.2	19.2	12.6	12.6	9.9	9.9	17.4	17.0	11.3	11.3	22.3	22.3
25. Ratio Predicted:Observed Blood Lead	0.9	1.0	1.1	1.1	0.7	0.8	0.9	1.1	0.9	0.9	0.6	0.7
26. Number of children tested	13.0		13.0		33.0		22.0		10.0		12.0	

GC 106963

TRC

Herculaneum Blood Lead Study-1984 data   Date: 3/17/87

Sector-miles from plant stack	N-SW 0.5-1.0		N-SW 1.0-1.5		SW-S 0.0-0.5		SW-S 1.0-1.5		Festus	
1. Outdoor air lead (ug/m3)	0.5	0.5	0.1	0.1	0.8	0.8	0.1	0.1	0.2	0.2
2. Indoor air lead (ug/m3)	0.2	0.2	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1
3. Time spent outdoors (hours/day)	2.0	4.0	2.0	4.0	2.0	4.0	2.0	4.0	2.0	4.0
4. Time weighted average (ug/m3)	0.18	0.21	0.11	0.13	0.29	0.33	0.11	0.13	0.07	0.08
5. Volume of air respired (m3/day)	4.0	5.0	4.0	5.0	4.0	5.0	4.0	5.0	4.0	5.0
6. Lead intake from air (ug/day)	0.72	1.04	0.43	0.63	1.15	1.67	0.43	0.63	0.29	0.42
7. % deposition/absorption in lungs	35.0	60.0	35.0	60.0	35.0	60.0	35.0	60.0	35.0	60.0
8. Total lead uptake from lungs (ug/day)	0.3	0.6	0.2	0.4	0.4	1.0	0.2	0.4	0.1	0.2
9. Dietary lead Consumption (ug/day)										
a) natural food, indirect atmosphere	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
b) from solder or other metals	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
c) drinking water	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
d) atmospheric lead	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
e) undetermined sources	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
10. % absorption in gut	42.0	53.0	42.0	53.0	42.0	53.0	42.0	53.0	42.0	53.0
11. Dietary lead uptake (ug/day)	8	10	8	10	8	10	8	10	8	10
12. Street dust/soil lead (ug/g)	103	103	70	70	1022	1022	137	137	110	110
13. Indoor dust lead (ug/g)	1030	1030	850	850	2040	2040	170	170	700	700
14. Time weighted average (ug/g)	889	708	720	590	2006	1967	160	166	640	557
15. Amount of dirt ingested (g/day)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
16. Lead intake from dirt (ug/day)	53	45	43	35	120	110	10	10	40	33
17. % dirt lead absorption in gut	30	30	30	30	30	30	30	30	30	30
18. Lead uptake from dirt (ug/day)	16	13	13	11	36	33	3	3	12	10
19. Total lead uptake from lung and gut (ug/day)	24	24	21	21	40	44	11	13	20	20
20. % lead uptake from lungs	1.0	2.6	0.7	1.8	0.9	2.2	1.3	2.8	0.5	1.2
21. % lead uptake from diet	32.9	41.7	37.8	47.8	18.0	21.7	71.6	75.0	39.7	49.5
22. % lead uptake from dirt	66.0	55.7	61.4	50.4	81.1	76.2	27.1	22.2	59.8	49.3
23. Predicted Blood Lead	10	10	8	8	18	19	4	5	8	8
24. Observed Blood Lead	10.4	10.4	7.4	7.4	16.8	16.8	8.4	8.4	8.0	8.0
25. Ratio Predicted:Observed Blood Lead	0.9	0.9	1.1	1.1	1.1	1.1	0.5	0.6	1.0	1.0
26. Number of children tested	5.0		5.0		5.0		9.0		100.0	

Figure 9. (continued) Herculaneum

EPA s Integrated Lead Uptake/Biokinetic Model
Site: Toronto - Niagara Neighborhood

Date: 3/17/87
1973 - 1974

Analyst: RTB

	AREA 1 0 - 200 m Low	Mean	High	AREA 2 200 - 400 m Low	Mean	High
1. Outdoor air lead (ug/m3)	2	5	8	2	4	6
2. Indoor air lead (ug/m3)	0.6	1.5	2.0	0.6	1.2	1.8
3. Time spent outdoors (hours/day)	2	3	4	2	3	4
4. Time weighted average (ug/m3)	0.72	1.94	3.33	0.72	1.55	2.50
5. Volume of air respired (m3/day)	4	4.5	5	4	4.5	5
6. Lead intake from air (ug/day)	2.87	8.72	16.67	2.87	6.98	12.50
7. % deposition/absorption in lungs	35	48	60	35	48	60
8. Total lead uptake from lungs (ug/day)	1.0	4.2	10.0	1.0	3.3	7.5
9. Dietary lead Consumption (ug/day)						
a) natural lead, indirect atmosphere	2.4	2.4	2.4	2.4	2.4	2.4
b) from solder or other metals	7.2	7.2	7.2	7.2	7.2	7.2
c) drinking water	1.2	1.2	1.2	1.2	1.2	1.2
d) atmospheric lead	7	7	7	7	7	7
e) undetermined sources	1.2	1.2	1.2	1.2	1.2	1.2
10. % absorption in gut	42	48	53	42	48	53
11. Dietary lead uptake (ug/day)	8	9	10	8	9	10
12. Street dust/soil lead (ug/g)	877	5000	12000	225	1200	2300
13. Indoor dust lead (ug/g)	877	5000	12000	225	1200	2300
14. Time weighted average (ug/g)	877	5000	12000	225	1200	2300
15. Amount of dirt ingested (g/day)	0.06	0.06	0.06	0.06	0.06	0.06
16. Lead intake from dirt (ug/day)	53	300	720	14	72	138
17. % dirt lead absorption in gut	30	30	30	30	30	30
18. Lead uptake from dirt (ug/day)	16	90	216	4	22	41
19. Total lead uptake from lung and gut (ug/day)	25	103	236	13	34	59
20. % lead uptake due from lungs	4.1	4.1	4.2	7.7	9.8	12.7
21. % lead uptake from diet	32.2	8.8	4.3	61.2	26.8	17.1
22. % lead uptake from dirt	63.7	87.1	91.5	31.1	63.4	70.2
23. Predicted Blood Lead	10	41	90	5	10	24
24. Observed Blood Lead		33.0			26.0	
25. Ratio Predicted/Observed Blood Lead	0.3	1.2	2.7	0.2	0.5	0.9

Figure 10. Toronto 1973-1974

EPA's Integrated Lead Uptake/Biokinetic Model   Date: 3/17/87   Analyst: AIB
Site: Toronto - Niagara Neighborhood   1980-1985

	AREA 1 0 - 300 m Low	Mean	High	AREA 2 300 - 500 m Low	Mean	High
1. Outdoor air lead (ug/m3)	2.2	2.2	2.2	1	1.5	2
2. Indoor air lead (ug/m3)	0.66	0.66	0.66	0.3	0.45	0.6
3. Time spent outdoors (hours/day)	2	3	4	2	3	4
4. Time weighted average (ug/m3)	0.79	0.88	0.92	0.36	0.50	0.83
5. Volume of air respired (m3/day)	4	4.5	5	4	4.5	5
6. Lead intake from air (ug/day)	3.15	3.96	4.58	1.43	2.62	4.17
7. % deposition/absorption in lungs	30	40	60	35	40	60
8. Total lead uptake from lungs (ug/day)	1.1	1.6	2.8	0.5	1.1	2.5
9. Dietary lead Consumption (ug/day)						
a) natural lead, indirect atmosphere	2.4	2.4	2.4	2.4	2.4	2.4
b) from solder or other metals	7.2	7.2	7.2	7.2	7.2	7.2
c) drinking water	1.2	1.2	1.2	1.2	1.2	1.2
d) atmospheric lead	7	7	7	7	7	7
e) undetermined sources	1.2	1.2	1.2	1.2	1.2	1.2
10. % absorption in gut	42	40	33	42	40	33
11. Dietary lead uptake (ug/day)	8	9	10	8	9	10
12. Street dust/soil lead (ug/g)	1000	1000	2600	300	450	600
13. Indoor dust lead (ug/g)	1000	1000	2600	300	450	600
14. Time weighted average (ug/g)	1000	1000	2600	300	450	600
15. Amount of dirt ingested (g/day)	0.06	0.06	0.06	0.06	0.06	0.06
16. Lead intake from dirt (ug/day)	60	100	156	18	27	36
17. % dirt lead absorption in gut	30	30	30	30	30	30
18. Lead uptake from dirt (ug/day)	18	32	47	5	8	11
19. Total lead uptake from lung and gut (ug/day)	27	43	60	14	18	23
20. % lead uptake due from lungs	4.1	4.2	4.6	3.6	6.0	10.7
21. % lead uptake from diet	29.5	21.0	16.9	57.5	49.4	43.1
22. % lead uptake from dirt	66.5	74.7	78.5	38.9	45.0	46.2
23. Predicted Blood Lead	11	17	20	6	7	9
24. Observed Blood Lead		16.5			12.2	
25. Ratio Predicted:Observed Blood Lead	0.7	1.1	1.4	0.5	0.6	0.8
26. Number of children tested	7	7	7	23	23	23

GC 106966

TRC

EPA's Integrated Lead Uptake/Biokinetic Model   Date: 3/17/87   Analyst: RIB
Site: Kellogg, Idaho

	AREA 1			AREA 2			AREA 3		
	Low	Mean	High	Low	Mean	High	Low	Mean	High
1. Outdoor air lead (ug/m3)	0.05	0.22	0.90	0.08	0.11	0.39	0.04	0.1	0.19
2. Indoor air lead (ug/m3)	0.015	0.066	0.202	0.012	0.039	0.113	0.012	0.03	0.057
3. Time spent outdoors (hours/day)	2	3	4	2	3	4	2	3	4
4. Time weighted average (ug/m3)	0.02	0.09	0.39	0.01	0.05	0.16	0.01	0.04	0.08
5. Volume of air respired (m3/day)	4	4.5	5	4	4.5	5	4	4.5	5
6. Lead intake from air (ug/day)	0.07	0.38	1.96	0.06	0.23	0.81	0.06	0.17	0.40
7. % deposition/absorption in lungs	35	40	60	35	40	60	35	40	60
8. Total lead uptake from lungs (ug/day)	0.0	0.2	1.2	0.0	0.1	0.5	0.0	0.1	0.2
9. Dietary lead Consumption (ug/day)									
a) natural lead, indirect atmosphere	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
b) from solder or other metals	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
c) drinking water	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
d) atmospheric lead	7	7	7	7	7	7	7	7	7
e) undeterained sources	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
10. % absorption in gut	42	48	53	42	48	53	42	48	53
11. Dietary lead uptake (ug/day)	8	9	10	8	9	10	8	9	10
12. Street dust/soil lead (ug/g)	322	3074	10000	53	2632	20700	131	401	2913
13. Indoor dust lead (ug/g)	1910	3933	8193	221	2409	10395	412	1130	7863
14. Time weighted average (ug/g)	1645	3818	11593	193	2323	13030	349	974	4215
15. Amount of dirt ingested (g/day)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
16. Lead intake from dirt (ug/day)	99	229	696	12	131	830	22	58	373
17. % dirt lead absorption in gut	30	30	30	30	30	30	30	30	30
18. Lead uptake from dirt (ug/day)	30	69	209	3	39	249	7	18	112
19. Total lead uptake from lung and gut (ug/day)	38	78	220	11	50	259	15	27	122
20. % lead uptake from lungs	0.1	0.2	0.5	0.2	0.2	0.2	0.1	0.3	0.2
21. % lead uptake from diet	21.2	11.7	4.6	69.5	16.7	3.9	50.5	34.1	8.2
22. % lead uptake from dirt	78.7	88.1	94.9	30.3	83.1	95.9	49.3	65.6	91.6
23. Predicted Blood Lead	15	31	88	5	22	104	6	11	69
24. Observed Blood Lead		21.0			18.0			12.0	
25. Ratio Predicted:Observed Blood Lead	0.7	1.5	4.2	0.3	1.2	5.8	0.5	0.9	4.1
26. Number of children tested	5	5	5	13	13	13	14	14	14

Figure 12. Kellogg

Mean Blood Lead Concentrations (μg/dl)
For Area Nearest Smelter*

	Predicted	Observed	Ratio of Predicted to Observed
East Helena	15	14	1.1
Herculaneum*	19	19	1.0
Toronto 1974-1975	41	35	1.2
Toronto 1984-1985	17	16.5	1.1
Kellogg	31	21.0	1.5

Similar results were achieved in the outerlying areas, as a glance at the figures will show. The agreement is good and also conservative, i.e., predicting higher than measured on average.

* N-NW sector in the case of Herculaneum

5.0 CONCLUSIONS

The optimized uptake/biokinetic model, which included a dirt ingestion rate of 60 mg/day, provided excellent estimations of the blood lead concentrations of children living near the four sites used in the optimization process. This is in contrast to the overprediction exhibited by the model for these sites when either 100 μg/day or 200 μg/day were used.

The optimized uptake biokinetic model permitted the examination of three lead exposure pathways: inhalation, dietary consumption and dirt ingestion. At close-in areas where the mean blood lead concentration was above 15 μg/dl, soil and house dust were the overwhelming influences on children's blood lead levels. At distances further from the smelters, where blood lead concentrations are much lower, the relative influence of soil and house dust decreases and dietary intake is of somewhat greater importance. However, at no point does inhalation have a major impact on blood lead concentrations.

A separate calculation of the effect of reductions in ambient air lead concentrations can be provided now that a verifiable model is available. The calculation is independent of site. A reduction of 1 μg/m^3 in air, i.e., from 1.5 μg/m^3 to 0.5 μg/m^3 is predicted to result in a mean reduction of 0.34 μg/dl in children's blood lead concentration with a range of 0.2 to 0.5 μg/dl.

6.0 REFERENCES

1. U.S. EPA, Office of Air Quality Planning and Standards, Strategies and Air Standards Division, February, 1986. Draft Staff Paper, "Review of the National Ambient Air Quality Standards for Lead: Assessment of Scientific and Technical Information".

2. Panhandle District Health Department, Idaho Department of Health and Welfare, Center for Environmental Health, Centers for Disease Control and U.S. EPA, July, 1986, "Kellogg Revisited - 1983: Childhood Blood Lead and Environmental Status Report".

3. Lewis and Clark County Health Department, Montana Department of Health and Environmental Sciences, Center for Environmental Health, Centers for Disease Control and U.S. EPA, March, 1986, "East Helena, Montana - Child Lead Study - Summer 1983".

4. Wallace, B. and K. Cooper, 1985, "Lead, People and the Environment", A Report prepared for the Niagara Neighborhood Association, Toronto, Ontario.

5. Phillips, P.E. and D.L. Vornberg, 1986, "Pediatric Blood-Lead Levels in Herculaneum, Missouri - 1984.

6. Vornberg, D.L., 1987, St. Joe Lead Company, Personal Communication.

7. U.S. EPA, Office of Toxics Integration, Lead Smelters Study Group, 1983, "Report of the Dallas Area Lead Assessment Study".

8. U.S. EPA, Region VI, June 29, 1981, "Status Report on the Lead/Cadmium Study Conducted in Dallas and a Scenario of Possible Actions".

9. U.S. EPA, Office of Toxics Integration, Lead Smelters Study Group, April, 1982, "Report on Dallas, Texas Lead Study".

10. Trapp, R.J., C.C. Smith, C.J. Durrenberger, S.L. Dattner, 1984, "Developing Short-term Net Ground Level Concentration Limits for Lead", presented at the 77th Annual Meeting of the Air Pollution Control Association, San Fransico, CA.

11. Crosby, E.C. and V.K. Argento, 1981, "Environmental Concentrations of Lead and Cadmium in the Areas of Secondary Lead Smelters and a Battery Manufacturing Plant in Dallas, Texas", prepared for U.S. EPA, Air and Hazardous Materials Division, EPA Contract No. OT-0918-NTEX.

APPENDIX A

DESCRIPTION OF TEST DATA SETS

A DESCRIPTION OF TEST DATA SETS

Table A1 presents the ambient lead concentrations and blood lead values for Kellogg, Idaho, 1983, approximately two years after operations ceased at the local smelter. The data in Table A2 were collected as part of a comprehensive lead survey[2] and are of excellent quality with respect to representativeness and reliability. An interesting feature of the Kellogg data are the low ambient air lead concentrations in contrast to elevated levels found in the soil and dust.

The 1983 data for East Helena, Montana are presented in Table A3. These data also were collected as part of comprehensive survey[3] and are of excellent quality. In contrast to the Kellogg data, ambient air concentrations in East Helena were found to be somewhat elevated while soil and dust lead concentrations were lower at East Helena than were found at Kellogg.

Tables A3 and A4 present the Toronto, Ontario data for 1985 and 1974, respectively. Although the data in Tables A3 and A4 were obtained from a single report[4], the original measurements were made as parts of a number of studies. The lack of a comprehensive lead study reduces the overall confidence that can be placed in some of the data for the Toronto site. In general, the 1985 data are more representative than the 1974 data. The principal weakness in the 1985 data is the lack of indoor dust lead measurements.

The 1974 data suffer from this same weakness as well as having somewhat questionable values for air lead, soil lead and blood lead. However, since the problems associated with the 1985 and 1974 data are expected to be typical of other data sets, both data sets were included in the evaluations. An additional objective for using both Toronto data sets was the local cleanup in the late 1970's of soil with greater than 2600 ppm lead. Thus, the Toronto

TABLE A1

AMBIENT LEAD CONCENTRATIONS AND BLOOD LEAD VALUES FOR KELLOGG, IDAHO, 1983

Category	Area 1[a]	Area 2[b]	Area 3[c]	Source of Data and Comments
Outdoor Air Lead ($\mu g/m^3$)	0.22 (0.05-0.94)	0.13 (0.04-0.39)	0.10 (0.04-0.19)	Geometric mean and range obtained from Ref 2, Table 27
Street Dust/Soil Lead (ppm)	3474 (322-18400)	2632 (53-20700)	481 (151-2915)	Geometric mean and range given for "Soil 1", composite soil in Ref 2, Table 10
Indoor Dust Lead[1] (ppm)	3933 (1910-8193)	2489 (221-10395)	1138 (412-7865)	Geometric mean and range from Ref 2, Table 17
Blood Lead ($\mu g/dl$) Number of children tested	21 5	18 15	12 14	Ref 2, Table 5, data for 2 year old children only. Although only five 2 year old children were tested in Area 1, tests on children of other ages in Area 1 provided similar results

a) Area 1: 0-1 mile from smelter
b) Area 2: 1-2.5 miles from smelter
c) Area 3: 2.5-6 miles from smelter

TABLE A2

AMBIENT LEAD CONCENTRATIONS AND BLOOD LEAD VALUES FOR EAST HELENA, MONTANA 1983

Category	Area 1[a]	Area 2[b]	Area 3[c]	Source of Data and Comments
Outdoor Air Lead ($\mu g/m^3$)	3.9 (3-4.8)	1.1 (0.3-2)	0.2 (0.07-0.25)	Ref. 3, Table 17 Geometric Mean and Range
Street Dust/Soil Lead (ppm)	720 (81-3414)	217 (58-1252)	86 (54-237)	Ref. 3, Table 7 Geometric mean and range
Indoor Dust Lead (ppm)	1588 (240-18361)	561 (119-2651)	380 (80-1351)	Ref. 3, Table 11 Geometric mean and range
Drinking Water Lead ($\mu g/l$)	0.005	0.005	0.005	Ref. 3, p. 23
Blood Lead ($\mu g/dl$) Number of children tested	14 22	10 57	7 16	Ref. 3, Table 5 Mean values for 2 year old children, only

a) Area 1: 0-1 mile from smelter
b) Area 2: 1-2.5 miles from smelter
c) Area 3: more than 5 miles from the smelter

TABLE A3

AMBIENT LEAD CONCENTRATIONS AND BLOOD LEAD VALUES FOR THE NIAGARA NEIGHBORHOOD, TORONTO, ONTARIO, 1985

Category	0-300 meters From Smelter	200-500 meters From Smelter	Source of Data and Comments
Outdoor Air Lead $\mu g/m^3$	2.2	1.5 (1-2)	Ref. 4, p. 32 for 0-300 m, the value used for 200-500 meters was inferred from the text on pp. 91 and 92 as well as Figure C-4
Street Dust/Soil Lead (ppm)	1800 (1000-2600)	450 (300-600)	Ref. 4, 0-300 m used isopleths in Figure C-11.
Indoor Dust Lead (ppm)	1800 (1000-2600)	450 (300-600)	No measurements were made. Soil values were used
Blood Lead Number of Children Tested	16.5 7	12.2 23	Ref. 4, 0-300 m used 1985 data from Table C-3 for children 0-6 yrs., 200-500 m last paragraph p. 112 for children under 6 yrs., testing was done in 1984

TABLE A4

AMBIENT LEAD CONCENTRATIONS AND BLOOD LEAD VALUES FOR THE NIAGARA NEIGHBORHOOD, TORONTO, ONTARIO, 1974

Category	0-200 meters From Smelter	200-400 meters From Smelter	Source of Data and Comments
Outdoor Air Lead $\mu g/m^3$	5 (2-8)	4 (2-6)	Ref. 4, the values were inferred from the discussion on p. 92
Street Dust/Soil Lead (ppm)	5000 (877-12000)	1200 (225-2300)	Ref. 4, values are from the text on p. 104 referring to measurements made in 1973
Indoor Dust Lead (ppm)	5000 (877-12000)	1200 (225-2300)	No measurements were made. Soil values were used
Blood Lead Number of Children Tested	35 NA	26 NA	Ref. 4, Table C-13 data for children 0-4 years

data provided an opportunity to evaluate the model's ability to estimate the effect of a control measure.

Table A5 presents the 1984 data for Herculaneum, Missouri.[5,6] This data is of excellent quality and is notable in the considerable spatial resolution in the data provided by a total of ten direction/distance combinations.

GC 106977

TRC

TABLE A5

AMBIENT LEAD CONCENTRATIONS AND BLOOD LEAD VALUES FOR HERCULANEUM, MISSOURI, 1984

Direction Distance (miles)	NNW[A] 0.-0.5[B]	NNW .5-1	NNW 1-1.5	NNE 0-.5	NNE .5-1	WSW 0-.5	WSW .5-1	WSW 1-1.5	SWS 0-.5	SWS 1-1.5	Source of Data
Outdoor Air Lead $\mu g/m^3$	2.8	1.1	0.8	2.2	0.8	0.8	0.5	0.3	0.8	0.3	Ref. 5
Street Dust/Soil Lead (ppm)	1450	827	140	2550	500	2239	183	70	1022	157	Ref. 6
Indoor Dust Lead (ppm)	2000	1600	630	1610	975	1210	1030	850	2040	170	Ref. 6
Blood Lead	19.2	12.6	9.9	17.4	11.3	22.3	10.4	7.4	16.8	8.4	Ref. 5
Number of Children Tested	13	15	33	22	10	12	5	5	5	9	

A N-NW: direction of sector from smelter
B 0-0.5: distance in miles from smelter

EXHIBIT A

GOOD FAITH OFFER PARTICIPANTS

Ace Comb Company Inc.
Allied-Signal Inc. (for C&D Battery)
Allied-Signal Inc. (for Prestolite Battery)
Alter Trading Corporation
Asarco Incorporated
Ashley Salvage Co., Inc.
AT&T
Ben Greenburg Company
Berlinsky Scrap Corp.
Bob Keller Battery Warehouse, Inc.
Bryan Manufacturing Company
C. L. Downey Company
Campbell Soup Company
Cedartown Industries, Inc.
Chrysler Corporation
Cooper Industries (for The Bussmann Division of McGraw-Edison)
Crown Cork & Seal Co.
Douglas Battery Manufacturing Co.
Exide Corporation (for ESB)
Exide Corporation (for General Battery Corporation)
Federal Cartridge Corporation
Ford Motor Company
General Waste Products, Inc.
General Motors Corporation
General Motors Corporation (for Delco-Remy Div. of G.M.)
General Motors Corporation (for Fisher Body Div. of G.M.)
Gopher Smelting and Refining Co.
Gould, Inc.
Hornady Mfg. (for Western Gun & Supply)
Imperial Smelting Corporation
J. Solomon & Sons, Inc.
Johnson Controls (for Globe Union)
Kamen Iron & Metal of Kamen, Inc.
M. Gervich & Sons Incorporated
Mallin Bros. Co.
Mayfield Manufacturing Company (for 3-H Industries)
Mel's Battery (for Ohio New & Rebuilt Parts)
Mid-Missouri Metals Corp.
Missouri Iron & Metal Company, Inc.
Olin Corporation
Overland Metals
Pequea Battery
Pet Incorporated
Phillipp Brothers, Inc.
Price-Watson Company
Ranken Technical Institute

RBS Industries, Inc. (for Milford Rivet and Machine Company)
Roth Brothers Smelting Corporation
Samuel Hide & Metal
Sanders Lead Co., Inc.
Shapiro Sales Co.
Sioux City Compressed Steel
U.S. Department of Energy (for Stanford Linear Accelerator)
U.S.S. Lead Refinery, Inc.
Waddell Bros. Metal Co.
Wallach Iron & Metal
World Color Press, Inc.-Spartan Printing Division

KJL90A30.LRC (8/31/90 3:54pm)

EXHIBIT C

SCOPE OF WORK FOR THE REMEDIAL DESIGN AND REMEDIAL ACTION AT NL INDUSTRIES/TARACORP SITE Granite City, Illinois

I. PURPOSE

The purpose of this Remedial Action at the NL Industries/Taracorp NPL Site ("the NL Site" or "the Site") is to assess and abate the potential threats from direct contact, ingestion, and inhalation of soils, dust, and waste materials containing elevated levels of lead in accordance with this Scope of Work (SOW). All soils with lead concentrations greater than 1000 ppm in each subunit of the residential areas shall be excavated and consolidated with the NL/Taracorp pile. The final soil lead performance standard will be generated from the Health Assessment Survey set forth. The EPA Superfund Remedial Design and Remedial Action Guidance, the approved Remedial Design/Remedial Action (RD/RA) Work Plan, any current guidance provided by EPA at the time of entry of this Consent Decree, and this SOW shall be followed in designing and implementing this Remedial Action at the Site. In the event of any inconsistency between this SOW and the Consent Decree, the Consent Decree shall govern. Terms used herein shall have the same meaning as used in the Consent Decree.

Comment: *The purpose clause has been amended to reflect the changes set forth below and further explained in the correspondence to which this document is an exhibit.*

II. DESCRIPTION OF THE REMEDIAL ACTION TO BE CONDUCTED BY SETTLING DEFENDANTS

Settling Defendants shall perform the remedy described in this SOW. The remedy shall be designed, implemented, and maintained to achieve the standards set forth below. The standards and specifications of the major components of the remedial action for the Site that shall be designed and implemented by the Settling Defendants are:

Health Assessment Survey

A health assessment survey shall be conducted to determine if lead remaining in the soil around the Site has contributed to a health impact on the local population (that is, whether the local target population has elevated blood lead levels) and, if necessary, to generate a final soil lead clean-up level which is protective of public health. To set a cleanup level, blood lead data would be used in the following manner. First, the portion of the target population exhibiting blood lead levels in excess of 15 µg/dl would be determined. If the percentage was 8.4% or less, it would be assumed that U.S. EPA's performance criteria for blood lead levels have been met and cleanup would occur at the 1,000 ppm level. If the percentage exceeded 8.4%, multi-linear regression tools and additional environmental assessment data would be utilized to determine what cleanup level may be appropriate. Multiple linear regression based on the data gathered in the health assessment survey would be run to determine which environmental lead sources are the major contributors to blood lead. Then, a regression analysis would determine the relationship between soil lead and blood lead. The cleanup level would assure that soil lead does not contribute to a health impact. To provide U.S. EPA with data to evaluate our result in light of the agency's Record of Decision, the results of the regression analysis would be confirmed using the Integrated Uptake/Biokinetic Model (substituting real data values for default factors) and compared with those obtained through the linear regression analyses.

Comments: *A longer narrative explaining this methodology is set forth in the cover correspondence.*

Elements of the health assessment survey will include the following as appropriate to be approved by U.S. EPA:

1. A demographic survey to identify: the target populations to be sampled; characteristics of the populations; and the size of the populations.

2. A blood lead program to: define appropriate blood lead sampling and analytical protocols; define other data collection requirements; implement said protocols; and report results of the program. All individuals shall be notified of their study results. Individuals with elevated blood lead levels will be advised to consult with their physician and/or public health officials.

3. An environmental assessment to identify potential confounding lead sources within the homes and outside environment of persons within the sample populations. The environmental assessment will include a survey of a statistically significant number of homes and provide for: a general inspection of indoor and outdoor conditions; an analysis of lead in paint and house dust; characterization of corrosivity and lead levels in the municipal drinking water supply at the home; and an analysis of lead in residential soil. The residential soil survey shall consist of the collection

of samples from at most three stations at each home at 0-3 inches and 3-6 inches and subsequent analysis for lead. Environmental assessment media shall be sampled and analyzed, if necessary, based upon results of blood lead program.

4. The final soil lead performance standard will be generated using multiple linear regression and regression analysis and other environmental assessment data confirmed by the use of the Uptake/Biokinetic Model.

Soil Sampling/Inspection

Soil lead sampling shall be conducted in Area 1 and the residential areas identified as Areas 2 and 3 in the RI/FS Reports, which have areas of estimated lead levels above 1000 ppm. This sampling shall be performed to determine the area extent and depth to which residential soil must be excavated to achieve at least a 1000 ppm soil lead cleanup level and the depth to which Area 1 must be excavated to achieve a 1000 ppm cleanup level. This sampling shall be coordinated with the health assessment survey to avoid duplication.

Inspections of alleys and driveways in Venice, as identified in Figure 7 of the ROD, shall be conducted to determine which specific areas, through visual criteria, indicate the presence of battery casing materials.

A physical survey will be conducted in Eagle Park Acres to locate the potential ditch identified in Figure 6 of the ROD and the extent of any potential battery casings.

Comment: *U.S. EPA's decision to conduct the inspections called for in its Scope of Work for previously unidentified areas where battery casings allegedly came to rest is unnecessary without more solid documentation of an actual problem. The agency should first document whether there is a problem by, for instance, following up on the leads given to the agency during the comment period to determine whether there are previously unidentified areas. We would also like to know who caused the casings to be moved in the first instance and join them in any response action.*

Aerial Photographs/Topographic Maps

For purposes of performing the health assessment survey, the soil sampling, and other activities outlined in this SOW, a review of existing aerial photographs, topographic maps, or other maps will be performed to determine if existing maps are sufficient. If existing maps are determined by the Settling Defendants to be inadequate, the Settling Defendants will undertake the required actions to prepare the necessary maps or to develop the required information.

Taracorp Drums

All drums on the NL/Taracorp pile identified in Figure 2 of the ROD shall be removed and transported to an off-site secondary lead smelter for lead recovery.

St. Louis Lead Recyclers Piles (SLLR Piles)

All wastes contained in the SLLR piles identified in Figure 2 of the ROD shall be consolidated into the NL/Taracorp pile.

Alleys and Driveways in Venice

Based upon visual evidence, any observed battery casing material will either be excavated or sealed depending upon the cost effectiveness of these alternatives. Any removed materials will be consolidated with the NL/Taracorp pile.

Eagle Park Acres

Based upon visual evidence, any observed battery casing material will either be excavated or capped depending upon the cost effectiveness of these alternatives. Any removed materials will be consolidated with the Taracorp pile.

Comment: *See immediately preceding comment.*

Area 1

Based upon the sampling outlined in the Soil Sampling/Inspection paragraph above, all unpaved portions of Area 1, including the material which is beneath the SLLR pile, with lead concentrations greater than 1000 ppm shall be excavated and consolidated with the Taracorp pile with the limitation that the depth of excavation shall not exceed the level necessary to construct a uniform asphalt cover. The surfaces shall be restored with asphalt or sod, in accordance with present usage. Soils that will be covered by the multimedia cap shall not be excavated.

Residential Areas

Based upon the sampling outlined in the Soil Sampling/Inspection paragraph above, an accurate mapping of residential soils with a lead concentration greater than 1000 ppm shall be provided. All soils with lead concentrations greater than 1000 ppm in each subunit of the residential areas indicated on the map shall be excavated and consolidated with the NL/Taracorp pile. If the health assessment survey results in a performance standard less than 1,000 ppm, then the soil will be remediated to that level. The surfaces shall be restored in accordance with present usage. Every effort shall be made to remediate sensitive areas (school yards, playgrounds, areas with highest lead concentrations, etc.) first, and no trees or structures or large vegetation shall be removed.

Comments: *See previous comments.*

Dust Control Measures

During all excavation, transportation, and consolidation activities conducted as part of the remedy, dust control measures shall be implemented as necessary to prevent the generation of visible emissions during these activities.

NL/Taracorp Pile - Multimedia Cap

After all materials have been transported to and consolidated with the NL/Taracorp pile, the consolidated pile shall be graded and capped with a multimedia cap. The cap shall consist of a: 6-inch bedding layer; geotextile membrane; HDPE or VLDPE liner; geonet membrane; 18-inch protective soil layer and a 6-inch top soil layer. The soil layer will be vegetated to minimize erosion. No bottom liner is necessary since the installation of the multimedia cap will prohibit the infiltration of surface water into the consolidated pile.

Comment: *The cap proposed above meets RCRA performance criteria.*

Institutional Controls/Fencing

A fence shall be constructed in a manner sufficient to prevent access to the expanded NL/Taracorp pile. Warning signs shall be posted at 200-foot intervals along the fence to indicate "Danger -Unauthorized Personnel Keep Out."

Comment: *This action benefits Taracorp's property and should be performed by Taracorp. Similarly, other actions included in the Scope of Work which benefit current property owners should be undertaken by the parties receiving the benefit.*

Groundwater Monitoring

One deep well upgradient and three deep wells downgradient from the NL/Taracorp pile will be installed to monitor groundwater quality in the lower portion of the upper aquifer. The four deep wells, together with six of the most appropriate existing site wells, will be analyzed semi-annually for lead for a period of 30 years or until a 5-year review (whichever is less) concludes that groundwater monitoring is no longer necessary.

The EPA Record of Decision for the site indicates that, collectively, a shallow and adjacent deep well at the site demonstrated elevated concentrations (as compared to background) of sulfates, dissolved solids, arsenic, cadmium, manganese, nickel, and zinc. Accordingly, the Settling Defendants shall monitor these parameters in the four newly installed wells and six other wells during the initial groundwater sampling event. If the results of the groundwater analyses from the initial sampling event indicate no statistically significant differences in water quality between the deep or shallow downgradient wells and the deep or shallow upgradient wells or if the concentrations in the deep or shallow wells do not exceed regulatory criteria, the groundwater will not be tested for these parameters during subsequent sampling events. If statistically significant differences are encountered and if regulatory standards are exceeded, monitoring for those parameters will be conducted and reviewed as described above for lead.

Air Monitoring

No air monitoring is necessary given that current in-depth IEPA ambient air surveys have demonstrated no concern to public health and the environment.

Air monitoring to be conducted during periods of soil excavation will be described in the Health and Safety Plan.

Comment: *Since the current situation has not produced an air problem, we cannot imagine why monitoring should be necessary after the remedy.*

Cap Monitoring

For a minimum of 30 years, annual inspections of the cap shall be conducted to identify areas requiring repair. Appropriate maintenance shall be conducted as soon as practical following the inspections.

Contingency Plans/Measures

The Health and Safety Plan will identify dust suppression methods which will be implemented to eliminate any adverse impacts which are encountered during excavation of soil or battery casings.

A groundwater contingency plan will be developed and implemented, if groundwater monitoring results, as discussed above, demonstrate degradation of a usable potable aquifer.

III. SCOPE

Settling Defendants shall prepare and submit to U.S. EPA for approval a RD/RA Work Plan which shall document the steps to be taken to implement the design, construction, operation and maintenance of the remedy. The Settling Defendants are responsible for the timely implementation of the RD/RA Work Plan. The RD/RA Work Plan shall include all elements described above.

The RD/RA Work Plan shall consist of two tasks, the schedule for submittal and review of which is delineated in paragraphs 13 and 14 of the Consent Decree:

Task I: RD/RA Work Plan

A. Statement of Work to be Performed
B. Quality Assurance Project Plan and Sampling and Analysis Plan
C. Fugitive Dust Control Plan
D. A Plan for Satisfaction of Permitting and Access Requirements

Task II: Remedial Design

A. Design Plans and Specifications
B. Project Schedule
C. Construction Quality Assurance Plan
D. Health and Safety Plan/Emergency Contingency Plan

Task I: RD/RA WORK PLAN

The Settling Defendants shall prepare a Work Plan which shall document the overall management strategy for performing the design, construction, operation, maintenance and monitoring of Remedial Actions. The plan shall document the responsibility and authority of all organizations and key personnel involved with the implementation. The Work Plan shall also include a description of qualifications of key personnel directing the RD/RA, including contractor personnel.

A. Statement of Work to be Performed

The Settling Defendants shall develop a concise Statement of Work to be performed which is consistent with the Description of the Remedial Action of this SOW.

B. Quality Assurance Project Plan (QAPP) and Sampling and Analysis Plan (SAP)

The Settling Defendants shall develop a QAPP and a SAP which shall be prepared in accordance with U.S. EPA's "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," (QAM-005/80) and subsequent amendments to such guidelines and shall outline, for all sampling except blood lead sampling which shall be conducted as part of this remedial action, numbers and locations of all samples to be taken, sampling, shipping, and analytical methods and procedures to be implemented, and quality assurance procedures to be used.

C. Fugitive Dust Control Plan

The Settling Defendants shall develop a Fugitive Dust Control Plan which shall outline, at a minimum, qualifications of personnel involved, methods to be employed to control visible emissions of fugitive dust, and corrective measures to be implemented in the event that visible emissions are observed.

D. A Plan for Satisfaction of Permitting and Access Requirements

The Settling Defendants shall develop a plan which shall outline and include, at a minimum, a comprehensive list of all permits required in conjunction with the remedial action, procedures and estimated time frames for acquiring required permits, procedures and methods to be implemented to ensure compliance with permitting requirements, a list of all properties to which access will be required in conjunction with the remedial action, sample access agreements for inspection soil sampling, and excavation activities, procedures and estimated time frames for acquiring required access, and procedures and methods to be implemented to obtain access and to follow up when access is not obtained.

Task II: REMEDIAL DESIGN

The Settling Defendants shall develop and submit to U.S. EPA for approval final construction plans and specifications to implement the Remedial Actions at the facility as defined in the Purpose, and the Description of the Remedial Action of this SOW.

A. <u>Design Plans and Specifications</u>

The Settling Defendants shall develop and submit to U.S. EPA for approval clear and comprehensive design plans and specifications which include but are not limited to the following:

1. Discussion of the design strategy and the design basis, including;

   a. Compliance with all applicable or relevant and appropriate environmental and public health standards; and

   b. Minimization of environmental and public impacts.

2. The constructability of the design;

3. Description of assumptions made and detailed justification of these assumptions;

4. Discussion of the possible sources of error and references to possible operation and maintenance problems;

5. Detailed drawings of the proposed design;

6. Tables listing equipment and specifications;

7. Appendices including;

   a. Sample calculations (one example presented and explained clearly for significant or unique design calculations);

   b. Derivation of equations essential to understanding the report; and

   c. Results of laboratory or field tests.

Comment: *The cost estimate section has been dropped. A number of the companies have substantial assets and do not understand the utility of the cost estimate exercise.*

B. <u>Project Schedule</u>

The Settling Defendants shall develop and submit to U.S. EPA for approval a Project Schedule for construction and implementation of the Remedial Actions which identifies timing for initiation and completion of all critical path tasks. Settling Defendants shall specifically identify dates for completion of the project and major interim milestones. An Initial Project Schedule shall be submitted simultaneously with the draft Design Document submission and the Final Project Schedule with the Final Design Document.

C. Construction Quality Assurance (CQA) Plan

1. Responsibility and Authority

The responsibility and authority of all organizations (i.e. technical consultants, construction firms, etc.) and key personnel involved in the construction of the corrective measure shall be described fully in the CQA plan. The Settling Defendants shall identify a CQA plan. The Settling Defendants shall also identify a CQA officer and the necessary supporting inspection staff.

2. Construction Quality Assurance Personnel Qualifications

The qualifications of the CQA officer and supporting inspection personnel shall be presented in the CQA plan to demonstrate that they possess the training and experience necessary to fulfill their identified responsibilities.

3. Inspection Activities

The observations and tests that will be used to monitor the construction and/or installation of the components of the Remedial Actions shall be summarized in the CQA plan. The plan shall include the scope and frequency of each type of inspection. Inspections shall verify compliance with the environmental requirements and include, but not be limited to air quality and emissions monitoring records, waste disposal records (e.g., RCRA transportation manifests), etc. The inspection shall also ensure compliance with all health and safety procedures. In addition to oversight inspections, the Settling Defendants shall conduct the following activities.

a. Preconstruction inspection and meeting with U.S. EPA

The Settling Defendants shall conduct a preconstruction inspection and meeting to:

i. Review methods for documenting and reporting inspection data;

ii. Review methods for distributing and storing documents and reports;

iii. Review work area security and safety protocol;

iv. Discuss any appropriate modifications of the construction quality assurance plan to ensure that site-specific considerations are addressed; and

v. Conduct a site walk-around to verify that the design criteria, plans, and specifications are understood, to outline the general approach to be employed to comply with the plans and specifications and remedial action goals, and to review material and equipment storage locations.

The preconstruction inspection and meeting shall be documented by a designated person and minutes shall be transmitted to all parties.

b. Prefinal inspection

Upon preliminary project completion, Settling Defendants shall notify EPA for the purposes of conducting a prefinal inspection. The prefinal inspection shall consist of a walk-through inspection of the entire project site. The inspection is to determine whether the project is complete and consistent with the contract documents. Any outstanding construction items discovered during the inspection shall be identified and noted. Retesting will be completed where deficiencies are revealed. The prefinal inspection report shall outline the outstanding construction items, actions required to resolve items, completion date for these items, and date for final inspection.

Comment: *U.S. EPA's reference to treatment equipment is not appropriate at this site.*

c. Final inspection

Upon completion of any outstanding construction items, the Settling Defendants shall notify EPA for the purposes of conducting a final inspection. The final inspection shall consist of a walk-through inspection of the project site. The prefinal inspection report will be used as a checklist with the Final inspection focusing on the outstanding construction items identified in the prefinal inspection. Confirmation shall be made that outstanding items have been resolved.

4. <u>Sampling Requirements</u>

The sampling activities, sample size, sample locations, frequency of testing, acceptance and rejection criteria, and plans for correcting problems as addressed in the project specifications shall be presented in the CQA plan.

AN EVALUATION OF THE
UPTAKE/BIOKINETIC MODEL
DEVELOPED BY THE ENVIRONMENTAL
PROTECTION AGENCY
FOR PREDICTING CHILDREN'S BLOOD LEAD

TRC Environmental Consultants, Inc.

Prepared by:

Gale F. Hoffnagle, CCM
Richard T. DeCesar, Ph.D.

Prepared for:

Lead Industries Association

Project 3952-P51

May 1987

800 Connecticut Boulevard
East Hartford, CT 06108
(203) 289-8631

GC 106995

EXECUTIVE SUMMARY

This report sets forth the results of an evaluation of the "uptake/biokinetic" model developed by the Environmental Protection Agency as a means of relating children's blood lead concentrations to environmental and dietary exposure to lead. The evaluation was undertaken by TRC Environmental Consultants, Inc. under contract with Lead Industries Association, Inc. (LIA). The purpose of the model evaluation was to discover and analyze the impact of air lead concentrations at industrial point sources of lead on the blood lead concentrations in children living nearby.

The uptake/biokinetic model attempts to segregate and quantify each of three pathways of lead exposure to the human system: inhalation, diet and soil/dust ingestion. This segregation by pathway is potentially useful for developing control strategies aimed at reducing blood lead concentrations. To date, EPA has applied the model only to hypothetical situations, and not to specific sites or situations where data on environmental exposure and children's blood lead concentrations were available. In order to evaluate the model, this study has applied it to four lead smelter sites where sufficient data were available on environmental lead exposure: Herculaneum, MO; East Helena, MT; the Niagara neighborhood in Toronto, Ontario; and Kellogg, ID. In the case of Toronto, two sets of data, one before and one after a cleaning program have been used. With a single adjustment involving the assumed daily ingestion of dirt and dust by the average child, the model provides excellent agreement between predicted and actual blood lead concentrations at these sites. This adjustment even increases the effect of air lead concentrations over prior EPA model results. The model, therefore, appears to reproduce real world data reasonably well and thus despite the complexity of the problem is a

5. Documentation

Reporting requirements for CQA activities shall be described in detail in the CQA plan. This shall include such items as daily summary reports, inspection data sheets, problem identification and corrective measures reports, design acceptance reports, and final documentation. Provisions for the final storage of all records shall be presented in the CQA plan.

E. Health and Safety Plan/Emergency Contingency Plan

The Settling Defendants shall prepare a Health and Safety Plan for activities to be performed at the facility to implement the Remedial Actions, including a plan to be implemented in the event of a life-threatening situation or a release of hazardous substances to the environment.

EXHIBIT D

Comments on and Suggested Changes to the Draft Consent Decree

page 1 - second paragraph

We suggest: "In response to an alleged release of a..."

page 3 - top line

We suggest: "on the subject of addressing an alleged release"

page 4 - 1st paragraph

The Settling Defendants believe that the remedial action adopted by the EPA may not be necessary to assure protection of human health and the environment. This point in conjunction with actions which the Settling Defendants deem appropriate for the protection of human health and the environment are addressed fully in the correspondence to which this document is an exhibit and Exhibits B and C.

page 4 - 2nd paragraph

See immediately preceding comment. The Settling Defendants agree that any action taken pursuant to this Consent Decree should be deemed to be in accordance with section 121 of CERCLA, 42 U.S.C. § 9621, and with the National Contingency Plan (NCP).

page 4 - 3rd paragraph

As discussed fully in the correspondence to which this exhibit is attached, the Settling Defendants do not agree to implement the final remedial action plan currently adopted by EPA in the existing ROD or SOW.

paragraph 1.

The purpose of the Consent Decree, per the Settling Defendants' proposal, will be to perform the Work specified in that proposal. The paragraph should embody this concept.

paragraph 2.

No comment.

paragraph 3.

No comment.

paragraph 4. (Definitions)

"Cleanup Standards"

The cleanup standards will be those specified pursuant to the Settling Defendants' offer.

"Oversight Costs"

The Settling Defendants represent only a fraction of the potentially responsible parties identified by EPA. While the Settling Defendants agree to reimbursing EPA and the State for direct oversight costs, EPA should not impose indirect and overhead costs on the Settling Defendants. Imposing indirect costs on the Settling Defendants, as part of a settlement, serves as a deterrent to settlement. Accordingly, EPA should only assess direct costs on the Settling Defendants and attempt to recover indirect costs from non-participating PRPs. We suggest the following:

> "Oversight Costs" means any direct costs not inconsistent with the National Contingency Plan, actually incurred and paid by the U.S. EPA and the State of Illinois, in monitoring the compliance of the Settling Defendants with this Consent Decree, including but not limited to contractor costs, sampling and laboratory costs, and travel, but excluding indirect costs and any and all interest that accrues prior to the time that this decree is entered.

"Work"

The offer by the Settling Defendants comments on the ROD and the Scope of Work and proposes specific undertakings. The Settling Defendants do not agree to perform in accordance with these documents as they presently exist. Accordingly, this section must be subject to conformance with the Work to which the parties finally agree.

paragraph 5.

subsection (a). No Comment.

subsection (b). See above comments on "Work".

paragraph 6-8.

No comment.

paragraph 9.

To the extent that these actions are within the control of the Settling Defendants, no comment. However, only the present owners have the ability to perform certain actions. If the owners are not members of the Settling Defendants, the Settling Defendants do not have the power to agree to certain actions specified in this paragraph.

subparagraph (d)(1)

Constructing a fence will benefit Taracorp's property and thus should be performed by Taracorp. Accordingly, we suggest that the second clause be changed to "Owner Settling Defendants shall construct..."

subparagraph (d)(5)

Obtaining necessary easements or site access agreements will require the cooperation of landowners or occupants. The Settling Defendants cannot guarantee the necessary cooperation. Accordingly, we suggest starting the subparagraph as follows:

"Subject to the provisions set forth in Section X (Site Access) and Section XIII Force Majeure, ..."

paragraph 10.

subparagraph (a): No comment.

subparagraph (b):

This provision provides EPA with unbridled discretion to reject contractors which the Settling Defendants have identified. Some standard needs to be established by which the EPA's action can be measured should EPA fail to approve the Settling Defendants' selected contractors. Accordingly, we suggest addition of the following to the end of the paragraph: "EPA's approval shall not be unreasonably withheld."

subparagraphs (c) & (d): No comment.

paragraph 11.

The Scope of Work must be subject to the comments provided in the accompanying correspondence and the Work to which the Settling Defendants offer to perform. See above comments on "Work."

paragraph 12.

See above comments on "Work".

paragraph 13.

subparagraphs (a), (b) & (c).

See above comments on "Work".

subparagraph (c).

Approved plans should not be modified absent a showing of a danger to human health and the environment. Accordingly, we suggest adding the following at the end of the subparagraph:

"Approved plans will not be subject to change or modification by EPA absent a showing of danger to human health and the environment."

subparagraph (d).

See comments below on paragraph 14 (Approval Procedures)

subparagraph (e) - No comment.

paragraph 14.

subparagraph (a):

EPA appears to retain absolute authority to alter any work plan or other document submitted by the Settling Defendants. Documents submitted by the Settling Defendants will be produced pursuant to the best professional judgement of their engineers and contractors. Accordingly, EPA should not retain unbridled authority to unilaterally alter these documents. Accordingly, we suggest that a sentence be added to subparagraph (a) which states: "EPA's approval shall not be unreasonably withheld."

subparagraph (b):

This subparagraph needs to be modified in accordance with subparagraph (a). We suggest:

b. Upon approval of a submission by U.S. EPA, or pursuant to the final results of Dispute Resolution, Settling Defendants shall proceed to implement the work required.

subparagraph (d):

This subparagraph needs to be modified to conform to subparagraph (a). We suggest the following alteration:

"Settling Defendants may submit any disapproval, <u>or suggested</u> modifications <u>to which the parties cannot agree</u>..."

Also, implementation of non-disputed portions of any disputed submission should be a factor to considered in a petition for forgiveness of penalties under section 61. Accordingly, we suggest adding the following sentence:

"However, implementation of non-disputed portions of the submission shall be considered in any petition for forgiveness of penalties under paragraph 61 of this Consent Decree."

paragraph 15.

See above comments on "Work".

paragraph 16.

These provisions, allowing for modification of the SOW, should also permit the deletion of otherwise required work where it becomes apparent that the work is not necessary to achieve the Clean-up and Performance Standards. Accordingly, we suggest the following alteration starting on line 3:

> "... to provide for additional work needed to meet Clean-up and Performance Standards specified above <u>or the deletion of work which is not necessary to achieve those Standards.</u>

Also, alter subparagraph (a) by inserting "<u>or permissible</u>" after "necessary".

paragraph 18 - 20.

No comment.

paragraph 21.

EPA and State approval of laboratories should not be unreasonably withheld. Accordingly, we suggest inserting:

> "EPA and State approval of laboratories shall not be unreasonably withheld."

GC 107005

Also, EPA and the State should be permitted access only at reasonable times and with reasonable notice. Accordingly, we suggest inserting the following at the end of the second to the last sentence:

"..., at reasonable times and upon reasonable notice."

paragraph 22.

Access to facilities that are not owned by the Settling Defendants must be predicated on the cooperation of the owners/occupiers of the land. Accordingly, if the owners/occupiers of the Facility are not among the Settling Defendants, this provision will require modification.

paragraph 23.

The Settling Defendants may not be able to identify the properties to which access will be required within 30 days of the entering of the consent decree. Furthermore, access may be obtained for limited purposes, such as sampling, on a preliminary basis. It is not practicable or reasonable to obtain access for more intrusive actions, such as remedial measures, until it is known that such actions are required. Accordingly, we suggest the following replacement for the second sentence:

> "If appropriate access is not obtained despite best efforts, within 30 days of the date that Settling Defendants become aware that access will be required, Settling Defendants shall promptly notify the United States."

GC 107006

Also, Settling Defendants agree to reimburse U.S. for costs and expenses incurred in obtaining access. Any compensation that the U.S. may be required to pay to a property owner would obviously be included in these costs and expenses. Accordingly, specific reference to the compensation is superfluous and redundant. We suggest deleting the phrase:

"and any compensation that the United States may be required to pay to the property owner"

paragraph 24 - 26.

No comment.

paragraph 27.

Settling Defendants may rely on their contractors or engineers to prepare and submit monthly progress reports. Accordingly, we suggest the following modification to the first line:

"Settling Defendants <u>or their contractors, engineers or other representatives</u> shall prepare..."

Also, see above comments on "Work".

paragraph 28.

See above comments on "Work".

paragraph 29 - 30.

No comment.

paragraph 31.

Where the EPA RPM/OSC halts work required by this Consent Decree, this action should not subject the Settling Defendants to Stipulated Penalties where the stoppage results from a Force Majeure, as defined pursuant to this Consent Decree. Accordingly, we suggest inserting the following before the last sentence:

> "Where any halt to work pursuant to this section results from a Force Majeure, Settling Defendants shall not be subject to Stipulated Penalties."

paragraph 32 - 33.

No comment.

paragraph 34.

Under certain circumstances, non-attainment of Performance or Clean-up Standards may result from a Force Majeure. For example, if the Settling Defendants comply with all elements of a work plan agreed to by the EPA and the State, and for some unforeseeable cause, beyond the control of the Settling Defendants, the Standards are not achieved, this should be considered a Force Majeure for purposes of assessing penalties.

Accordingly, we suggest deleting, from the last sentence, the phrase:

"or non-attainment of Performance or Clean-up Standards"

paragraph 35.

Notice cannot be given until Settling Defendants become aware of the conditions that warrant such notice. Accordingly, we suggest the following revision starting on the fifth line as follows:

"... event, Settling Defendants shall, upon becoming aware of such circumstances, promptly notify..."

paragraph 36.

No comment.

paragraph 37.

In dispute resolution concerning a "force majeure" Settling Defendants have the burden of proof. The standard should be by a preponderance of the evidence. We suggest revising the last sentence as follows:

"In such a proceeding, Settling Defendants have the burden of proof, by a preponderance of the evidence, that the event..."

paragraph 38-39.

No comment.

paragraph 40.

subparagraph (a).

In submitting a "Statement of Position", parties should not be required to submit copies of documents which have been previously submitted or which are readily available to the opposing party. Accordingly, parties should be permitted to include supporting documentation by reference, where appropriate. We suggest adding the following sentence:

> "A Statement of Position may incorporate by reference, and thereby include, supporting documents previously submitted to the other party or documents which are readily and easily accessible to the public."

subparagraph (c).

While this provision requires EPA to provide notice prior to the date that the administrative record is closed, it is not clear that the parties may submit material to be incorporated up until that time. We suggest revision to the second sentence as follows:

> "The record shall include the Formal Notice of Dispute, the Statements of Position, all supporting documentation

submitted by the parties at any time prior to the close of the record, and any other material..."

paragraph 41-43.

No comment.

paragraph 44.

To the extent that dates for performance are made relative to prerequisite actions, we have no comment on this provision. If dates of performance are not relative, delays in EPA approval, delays during reasonable good faith dispute resolution, etc., will result in cascading delays and penalties. Upon resolution of a dispute or correction of a deficiency, penalties should not continue to accrue once work expeditiously resumes.

paragraph 45-46.

No comment.

paragraph 47.

No comment.

paragraph 48.

No comment.

paragraph 49.

subparagraphs (a) & (c).

It is objectionable for EPA and the State to seek past costs from the Settling Defendants where those defendants represent only a small portion of the PRPs identified by EPA. EPA should pursue non-settling PRPs for reimbursement of past costs. Accordingly, this subsection should be deleted.

subparagraph (b).

See above comments on "Work". Since Settling Defendants agree to perform the Work, this paragraph is unnecessary. Furthermore, U.S. EPA has stated that the study it proposed would not affect the remedy. If not, the study would not be a response cost. If the study is used as part of the remedial actions as proposed in this offer, it would be a response cost.

paragraph 50.

Settling Defendants will not reimburse the United States or the State for costs that are inconsistent with the National Contingency Plan. Response costs other than Oversight Costs should be imposed upon non-settling PRPs. If the Settling Defendants are required to pay any other response costs, incentive to settle is greatly reduced. Accordingly, we suggest the following substitute paragraph:

"Settling Defendants shall pay Oversight Costs which are consistent with the National Contingency Plan, costs of access pursuant to Section X hereof, and all costs incurred in enforcing this decree, as incurred and paid by the United States and the State."

paragraph 51.

The first sentence makes no sense and should be deleted. Furthermore, the United States and the State should submit documentation to support claims made. We suggest the following substitute paragraph:

"The United States and the State shall, as practicable, periodically submit claims for costs pursuant to the preceding paragraph. All submissions shall include supporting documentation, including but not limited to invoices, bills and statements. Payments shall be made within 30 days of the submission of the above claims, unless such claims are disputed. If claims are disputed, the party may initiate dispute resolution."

paragraph 52.

No comment.

paragraph 53.

Regarding compliance with the SOW, see above comments on "Work". Imposition of penalties for failure to complete <u>any</u> requirement of the Decree is overly broad, particularly considering the lowest level of stipulated penalty. Imposition of Stipulated Penalties for insignificant, technical, or *de minimis* violations of the Decree do not serve the purposes of the EPA or the public. Some of the essential purposes of Stipulated Penalties are to avoid unnecessary and time consuming disputes, including delays inherent with judicial action and collection of statutory penalties. If Stipulated Penalties are indiscriminately applied, their value will be lost. Accordingly, Stipulated Penalties should apply to specific tasks, similar to those presently enumerated (however, the enumerated tasks must be modified to conform to the rest of the Settling Defendants' offer). We suggest the following, with appropriate redrafting upon development of further information concerning the SOW pursuant to the underlying agreement:

> "Settling Defendants shall be liable for stipulated penalties, in accordance with the following, for each day the Settling Defendants fail to complete a designated deliverable or task in a timely manner or fail to produce a designated deliverable of acceptable quality, except as specified in paragraph 55 of this Decree.... [redraft of subparagraphs 1-11 with specific enumerated milestones and appropriate penalty amounts ($500, $1,000, $1,500)].

paragraph 54.

Stipulated penalties should not be unlimited. The unlimited potential for penalties does nothing to serve the ostensible purpose of stipulated penalties, i.e. to provide for an efficient and easy administrative mechanism to assess penalties sufficient to assure timely compliance. If the process of performance under the Decree breaks down completely, stipulated penalties cease to serve their purpose and the underlying fundamental problem with implementing the Decree should be addressed using other mechanisms, such as injunctive relief and statutory penalties. Accordingly some cap should be place on EPA's ability to assess stipulated penalties.

Also, EPA should choose whether to pursue stipulated penalties or statutory penalties. If EPA assesses and accepts payment of stipulated penalties EPA should be precluded from also seeking statutory penalties for the same violation as permitted by paragraph 64 of this Decree.

We suggest the following additions:

> "In no event shall the total of all stipulated penalties assessed under this Decree, including interest and other fees, exceed $1 Million. If EPA assesses and accepts payment of stipulated penalties for an alleged violation of this Decree, EPA shall not seek any other remedy concerning the same violation."

paragraph 55.

Stipulated penalties should not be unreasonably imposed for periods during revision of submitted documents. Creation of appropriate documents required for satisfactory completion of the Work required by this Decree is a naturally iterative process.

It is inevitable that EPA will have some comments, requiring some form of modification, on documents submitted pursuant to this decree. Furthermore, while a document may be originally submitted in a timely manner, EPA may not provide comments until a later date. Should the parties agree to appropriate revisions pursuant to comments, it would be unfair to permit EPA to impose stipulated penalties for the period that the EPA reviewed the document. A reasonable connection should be made between EPA's notification of deficiency and the accrual of stipulated penalties. Accordingly, we suggest the following addition:

> "However, for violations not based on timeliness, stipulated penalties shall not begin to accrue until after the Settling Defendants have had the opportunity to revise the submission in accordance with EPA's written comments. If any revised submission fails to respond to EPA's comments and EPA deems such failure to be a violation, then EPA will provide the Settling Defendants with written notice of such violation. In such case, the stipulated penalties shall accrue from the later of (a) the due date of the revision, or (b) ten days preceding the Settling Defendants' receipt of such notice.

paragraph 56.

No comment.

paragraph 57.

Settling defendants must also be provided the right to dispute the right of the United States to penalties, as well as to the stated amount of such penalties. Accordingly, we suggest the following revision of the first sentence:

> "Settling Defendants may dispute the Untied States' right to penalties or the stated amount of penalties..."

paragraph 58.

No comment.

paragraph 59.

No comment.

paragraph 60.

No comment.

paragraph 61.

This paragraph is good. However, a petition for forgiveness should also be allowed where stipulated penalties are based upon a failure to achieve a milestone in a timely manner and the Settling Defendants correct that failure and also subsequently return to the original time frame. Also, continuation and performance of other undisputed tasks should be considered in determining whether forgiveness is appropriate. Accordingly, we suggest addition of subparagraphs 61(4) and (5) as follows:

"..., (4) where stipulated penalties are based upon a failure to achieve a milestone in a timely manner and the Settling Defendants correct that failure and also subsequently return to the original time frame, and (5) when the Settling Defendants have continued to perform undisputed tasks in a timely manner."

paragraphs 62 - 63.

No comment.

paragraph 64.

As noted above in comment to paragraph 54, EPA should choose their remedy. Double penalties should not be permitted, i.e. both stipulated and statutory penalties. Accordingly we suggest the following revision to the last sentence:

"Except as provided in paragraph 54, payment of stipulated penalties..."

paragraph 66.

Natural resources damages should be a Covered Matter. Exclusion of natural resources damages from the Covered Matters deters willingness to settle as this may represent a large and unknown amount. Furthermore, EPA may pursue non-settling defendants for recovery of natural resources damages, thereby creating an incentive for parties to join the Group of Settling

Defendants. Accordingly, we suggest the deletion of subparagraph 66(b).

paragraph 67.

This provisions is overly broad and could, arguably, permit EPA to require further action based upon any information received subsequent to entry of this Decree, regardless of the quality or nature of that information. Accordingly, EPA should have the burden of proof if EPA requires further action based upon "new information". Accordingly, we suggest the following addition:

> "If EPA or the State requires new action or additional response work subsequent to the entry of this decree or certification of completion, based upon receipt of additional information, EPA shall have the burden of proof and production in establishing that such additional response work or new action is required.

paragraph 68.

No comment.

paragraph 69.

See above comments under "Work".

paragraph 70.

There is no reason for the Settling Defendants to release and waive all rights to or against the State or the United

States. For example, the Settling Defendants should preserve their rights in the event that EPA or the State causes harm or damage due to negligence or some other actionable event. We suggest that this provision be deleted or appropriately modified.

paragraph 71.

The Settling Defendants also should have their rights preserved. Accordingly, the last sentence should be modified as follows:

> "The United States, the State, <u>and the Settling Defendants</u> expressly reserve the right..."

paragraph 72.

Settling Defendants that are expending their own money, resources and personnel should not be required to totally indemnify the United States and the State. The indemnification should be limited to acts or omission that are negligent or wrongful. Also, if EPA or the State directs those actions, the indemnification is not appropriate. Accordingly, the fourth line should be modified as follows:

> "arising from the <u>negligent</u> acts or omissions..."

and, at the end of the first sentence, add:

GC 107020

"except to the extent that an act or omission was directed by EPA or the State over the objection of the Settling Defendants."

paragraph 73.

No comment.

paragraph 74.

No comment.

paragraph 75.

No comment.

paragraph 76.

The amount of financial security should be reduced to $8 million.

paragraph 77-84.

No comment.

paragraph 85.

See above comments on "Work". Assuming that Certification of Completion applies to the Work to which this Decree applies, certification as to the truth and accuracy of the Notification of Completion should not be required. EPA will oversee the entire project and will review the monthly progress reports. EPA should be aware as to the completion of the Work, regardless of the

Notification of Completion. Furthermore, some documents and actions may have been subject to modifications by EPA which, in the opinion of the Settling Defendants' Engineers and Contractors make them not entirely "true and accurate". Also, the scope of the data that must be "certified" is unclear. Accordingly, certification should not be required. Therefore we suggest deletion of the last sentence of subparagraph (a).

paragraph 86

Insert "alleged" on the third line after "parties that the..."

GC 107022

ADJUSTMENTS IN THE LEAD UPTAKE/BIOKINETIC MODEL TO PREDICT BLOOD LEAD LEVELS FOR CHILDREN AT GRANITE CITY

Prepared by:

Gale F. Hoffnagle, CCM

Gary L. Ginsberg, Ph.D.

Prepared for:

Sidley and Austin

Project No. 8084-R51

August 30, 1990

TRC

Environmental Consultants, Inc.

800 Connecticut Boulevard
East Hartford, CT 06108

(203) 289-8631

A TRC Company

TABLE OF CONTENTS

GC 107024

1.0 SUMMARY AND CONCLUSIONS

1.1 Basis for EPA's Determination of a 500 ppm Soil Remediation Level for Granite City

The ideal basis for judging the need to remediate Pb from soil is current blood Pb and environmental Pb data for children at Granite City. These data would allow for the determination of whether soil has had an adverse impact on health and to what extent soil Pb reductions will remove any impact. However, only a 1982 blood Pb survey at this site is available. While this study is important in demonstrating that blood Pb levels at Granite City are not expected to be elevated, this study is not sufficient to form the basis for a soil remediation decision. In lieu of direct evidence, EPA has depended upon the Lead Uptake/Biokinetic Model. This model is intended to predict blood Pb levels that could be expected based upon an analysis of the factors governing Pb exposure and absorption from air, water, diet, soil and household dust. The safety criteria for blood Pb levels, as determined by EPA for Granite City, is that no more than 5% of the children should have a blood Pb level greater than 15 μg/dl.

EPA ran the Uptake/Biokinetic Model at a soil Pb and a house dust Pb level of 1,000 ppm, to determine if a 1,000 ppm clean-up level would present an unacceptable risk. This analysis yielded a mean blood Pb level of 11.86 μg/dl, with 34% of the children predicted to have levels greater than the 15 μg/dl cutoff. This analysis thus predicted that at 1,000 ppm, a high percentage of children would have blood Pb levels might be expected to be in the unacceptable range. EPA then evaluated the utility of soil remediation by using 500 ppm for soil and house dust Pb instead of 1,000 ppm. With these inputs, the model predicted a mean blood Pb level of 8.37 μg/dl, with 8.4 percent of the population above 15 μg/dl. EPA concluded that the reduction of soil Pb to 500 ppm would produce substantial improvements in Granite City blood Pb levels, and that at 500 ppm, the percentage of the population above 15 μg/dl would be close to the target (5%). This percentage above 15 μg/dl (8.4%), was judged to be acceptable because the expected future reductions in dietary, water and ambient Pb should bring Granite City blood Pb levels to within the acceptable range. Thus, EPA used the Uptake/Biokinetic Model as justification for and evidence that 1,000 ppm Pb in Granite City soils is unacceptable, and that remediation to 500 ppm is protective of public health.

1.2 Flaws in EPA's Use of the Uptake/Biokinetic Model Which Caused Unrealistic Predictions of Granite City Blood Pb Levels

1.2.1 Flaws Which Inflated Predictions of Blood Pb at 1,000 ppm Pb in Soil

The major flaws in EPA's use of the Model were that dietary Pb ingestion was greatly overestimated, and that Pb absorption from soil and house dust was also overestimated. The improper application of these parameters led to a grossly inflated prediction of blood Pb levels at Granite City.

Dietary Pb levels have decreased dramatically over the past 8 years due to the removal of Pb from gasoline and from solder used for food cans. This decline in dietary Pb exposure is associated with decline in the national average blood Pb levels over this period.

In a 1989 document describing its use of the Model (EPA, OAQPS, 1989), EPA recognized that the current dietary Pb intake is approximately 3 fold below that from 1982. In addition, EPA decided to use these up-to-date dietary Pb values in subsequent runs of the Model (EPA, OAQPS, 1989; Cohen, 1990). However, in their application of the Model to Granite City (EPA, 1990), EPA utilized 1982 dietary Pb levels. This inappropriate use of the Model led to a 32% inflation in the prediction of Granite City blood Pb levels.

In their model predictions for Granite City, EPA assumed that Pb absorption from soil and house dust would be 30%. This means that 30% of the

Pb ingested with soil/dust would be absorbed from the gut and become incorporated into the blood. However, the relationship between soil Pb level and the absorbability of Pb from soil is not straightforward. As soil Pb levels increase, the efficiency of the gut to absorb Pb decreases, leading to a lower percent Pb absorption at high soil Pb levels (EPA, 1986). While EPA has recognized that Pb absorption decreases as soil Pb levels rise (EPA, OAQPS, 1989; Cohen, 1990), the Agency has not systematically analyzed this relationship, nor have they incorporated a more realistic soil absorption value into runs of the Model for Granite City.

TRC has made this analysis and has adjusted the soil Pb and house dust Pb absorption parameters used in the Model to reflect actual blood Pb, soil Pb and house dust Pb data. TRC then incorporated these parameters into Model runs for Granite City. As described below, the predictions of Granite City blood Pb levels stemming from this "best fit" version of the Model are 45% below the highly inflated prediction obtained by EPA.

1.2.2 <u>Flaws Which Inflated Predictions of the Benefits of Soil Remediation</u>

In failing to account for the difference in Pb absorption at 500 vs. 1,000 ppm Pb in soil/dust, EPA overestimated the benefit of soil remediation. In actuality, the decrease in Pb exposure produced by soil remediation will be partially offset by the increased efficiency in Pb absorption at lower soil/dust Pb levels (as described above). Thus, soil remediation becomes a matter of diminishing returns as soil levels are reduced to levels below 1,000 ppm. EPA did not recognize this in their model prediction for the benefit which might be derived from soil remediation. This factor alone decreases the Agency's prediction of remediation benefit from 29% benefit to 18% benefit.

The remediation benefit also has to be adjusted to reflect the fact that remediation of soil Pb will not produce a similar decline in house dust Pb.

Soil remediation will not impact indoor sources of house dust Pb (e.g., lead paint), and so remediation of soil Pb can only yield limited declines in dust Pb levels. Because of indoor Pb sources, house dust Pb levels are consistently greater than soil Pb levels: this is especially so at low soil Pb levels. An analysis of 12 current and former smelter sites indicates that at soil Pb levels of 500 ppm, the most likely house dust Pb level is 784 ppm. Since the majority of soil/dust ingestion occurs indoors, the small decline in house dust Pb substantially diminishes the impact of soil Pb remediation. Therefore, EPA's assumption that declines in house dust Pb levels will parallel declines in soil Pb levels is overly optimistic, and inflates EPA's prediction of the benefit which might be achievable from soil remediation.

1.3 TRC's Approach to Using the Uptake/Biokinetic Model for the Prediction of Blood Pb Levels at Granite City

1.3.1 Correction of the Dietary Pb Ingestion Input to the Model

Dietary Pb has declined in recent years to levels well below those levels used by EPA in the model runs of Granite City, and are expected to decline further in the near future. Therefore, TRC has updated the model by incorporating the most recent estimation of dietary Pb levels for 0-6 year old children (EPA, 1989; Cohen, 1990). This correction decreases the prediction for Granite City blood Pb levels at 1000 ppm Pb in soil from 11.86 μg/dl with 34% of the children above 15 μg/dl (EPA's prediction), to 8.96 μg/dl with 12% of the children above 15 μg/dl. It is noteworthy that in the Record of Decision (ROD) for Granite City (EPA, 1990), EPA judged that a mean blood Pb level of 8.37 μg/dl would be acceptable for Granite City. Thus, by correcting the model to account for current dietary Pb intake, the prediction for blood Pb becomes similar to that which was acceptable in the ROD.

GC 107028

1.3.2 Adjustment of Soil Pb Absorption

EPA has recognized that the soil Pb absorption parameter needs to be adjusted to obtain a better fit of the model to actual blood Pb data. Further, the agency has suggested that when soil Pb levels are elevated, such as the case around smelters, the appropriate soil Pb absorption factor is 20%, rather than the default value of 30%. This is an important adjustment to the model which substantially impacts the relationship between soil Pb and blood Pb. However, EPA has not, as yet, quantified the decline in soil Pb absorption as soil Pb levels rise, nor did the agency attempt to correct the model in this regard as it predicted blood Pb levels at Granite City.

To remedy this situation, TRC has utilized an extensive data set from a former smelter and mining site, Midvale, Utah, to study the relationship between Pb absorption and soil Pb levels. This data set is complete enough with respect to blood Pb and environmental Pb sources, to enable calculation of the absorption of Pb from soil for 109 children. This analysis demonstrated that the overall population mean Pb absorption from soil (32%) was similar to the EPA default value (30%). However, soil Pb absorption was well below this default value at 1000 ppm (16-21%) and close to this at value at 500 ppm (27%). This analysis was supported by examining four additional smelter sites, at which the best fit of the model to the blood Pb data was achieved if 18% soil Pb absorption was used in place of the default value. These analyses confirmed EPA's suggestion that a soil Pb absorption factor of 20% needs to be applied to cases where soil Pb levels are elevated. In runs of the model to predict Granite City blood Pb levels, TRC has used a soil Pb absorption factor of 19%.

1.3.3 Predictions of Granite City Blood Pb Levels from Runs of the Model Using Corrected Model Parameters

Adjustment of the model to correct the dietary Pb ingestion and soil Pb absorption inputs decreases the predicted mean Granite City blood Pb level by

83%, compared to EPA's prediction which was based upon out-of-date and realistic default values. This corrected analysis indicates that the mean blood Pb level is expected to be 6.47 μg/dl, with only 1.7% of the children expected to have levels greater than 15 μg/dl. This prediction is well within EPA's safety criteria for blood Pb (5% of the population with blood Pb levels >15 μg/dl), and suggests that remediation of Granite City soils to 1000 ppm should be protective of public health.

1.3.4 Use of the Corrected Model to Predict the Benefits Possible from Soil Remediation to 500 ppm

Predictions of Granite City Blood Pb Levels at 1000 ppm indicate that there is a high probability that 1000 ppm Pb in soil does not constitute a substantial adverse effect on childhood blood Pb levels. This indicates that it should be unnecessary to consider remediation to 500 ppm. However, since this is still at issue, TRC used the corrected model to predict the benefit which might occur by remediation to 500 ppm.

Using the simplistic assumption that remediation of soil Pb levels from 1000 to 500 ppm will result in a similar decline in house dust Pb, the corrected model predicted that blood Pb levels would decline by 19%. This decline is less than EPA's prediction for soil remediation benefit (30%) because the TRC analysis incorporates the increase in Pb absorption with decreases in Pb soil level. Thus, the decline in Pb exposure caused by remediation of soil would be partially offset by the increased efficiency in Pb absorption from soil at 500 ppm.

However, even this estimation of remediation benefit is overly optimistic, since soil remediation will not impact indoor sources of Pb (e.g., lead paint). At 500 ppm Pb in soil, the most likely house dust Pb level is not 500 ppm, but instead 784 ppm. This consideration greatly decreases the expected benefit from soil remediation, so that only a 7% benefit is likely. Thus, remediation of soil Pb to 500 ppm is expected to have only minor additional benefit over that which would be achieved by remediation to 1000 ppm. Additionally, since blood Pb levels at 1000 ppm are expected to be well within the safety criteria established by EPA in the ROD, soil remediation below 1000 ppm would not appear to be necessary.

1.4 The 1982 Granite City Blood Pb Survey in Comparison to Blood Pb Predictions Using the Corrected Model

The model has been re-calibrated to reflect the best available data, and confidence in its results is obtained from comparisons with blood Pb data from other smelter sites. However, it is best to avoid relying solely upon modeled predictions to make judgments concerning Pb soil remediation. Unfortunately, no current blood Pb study is available at Granite City, and this needs to be remediated before any remediation decision is made. However, the previous blood Pb survey at Granite City is only site-specific data available. Although these are shortcomings with this study (e.g., small sample size, inappropriate sampling period), the results are an important indicator of what type of results can be expected from a current survey at this site.

The 1982 survey results indicate that the Granite City blood samples analyzed contained Pb at concentrations that were typical of urban areas. This suggests that the soil Pb levels at Granite City did not have a major adverse impact on blood Pb. This result supports the predictions of the corrected model, in that both the model predictions and the actual blood Pb survey results indicate that soil Pb is likely not a major contributor to blood Pb at Granite City. The small effect that soil Pb appears to have on blood Pb at Granite City is consistent with results from other sites where ambient Pb levels are low, but soil Pb levels are high (Lead Criteria Document, EPA, 1986).

In total, evidence from the Granite City blood Pb survey, from other sites where soils are contaminated with Pb, and from runs of the corrected model indicate that there does not appear to be an immediate hazard due to Pb in soil at 1000 ppm or below. Further, the results of a future blood Pb survey will likely reveal that Granite City blood Pb levels are not substantially different from that which is typical in urban areas, and that soil Pb levels of 1000 ppm are associated with blood Pb levels that are within EPA's safety criteria. These considerations indicate that it is prudent to await the results of a new Granite City blood Pb survey before the soil remediation level is finally set.

2.0 APPROACH USED BY THE EPA TO DECIDE SOIL REMEDIATION ACTION LEVELS AT GRANITE CITY

2.1 Information Needed to Determine the Appropriate Soil Remediation Level

In order to set an action level for soil remediation, numerous factors must be considered. For Pb, these include the relationship between blood Pb levels and adverse health effects, pathways of Pb exposure, and the factors that govern the contribution of soil Pb to blood Pb. In addition, the population at greatest risk must be identified so that the remediation level is protective of this population. These factors are described in the following sections.

2.1.1 Relationship Between Blood Pb Levels and Adverse Health Effects

Blood lead levels as low as 10-15 µg/dl can be associated with a range of subtle effects including changes in red blood cell metabolism, central nervous system changes (altered electroencephalogram), and neurocognitive effects.

Additionally, reproductive effects such as low birth weight and premature birth have been associated with maternal blood Pb in this range. At higher blood Pb levels, there is a gradation of effects. At 40 µg/dl, clinical signs of Pb toxicity can occur, which include reduced ability of the blood to carry and deliver oxygen, and nerve dysfunction. At 80 µg/dl and above, renal injury and brain damage are possible.

Based upon this spectrum of effects, the EPA and Center for Disease Control (CDC) have set the blood level which is protective of children and public health at 10-15 µg/dl (EPA, 1990). The goal is that no more than 5% of the population would experience blood Pb levels greater than 15 µg/dl (EPA, 1990).

GC 107033

2.1.2 Lead Exposure Pathways

To determine the importance of soil Pb to blood Pb, the contributions from all relevant exposure pathways must be considered. For example, if non-soil Pb exposures are large relative to the soil Pb exposure, the remediation of soil Pb may have little impact on the total Pb exposure. The sources of Pb exposure that must be considered along with soil are airborne, dietary, water, and indoor (house dust) Pb. The major indoor Pb source is from Pb paint, which under certain circumstances (older homes, peeling paint) can far outweigh any other exposure source (Chisolm, 1985). The most important exposure sources are diet, indoor dust and soil, with approximately 25 to 35% of the total exposure coming from soil. These values come from incorporation of the factors governing Pb exposure sources into the Uptake/Biokinetic Model, as described in Section 2.2.

2.1.3 Population At Risk

The population at greatest risk, and thus, the population for which the Uptake/Biokinetic Model is structured, is young children (0-6 years old). Young children may be more susceptible to the toxic effects of Pb because their nervous system is still developing, and because they may absorb Pb more efficiently than adults (Farfel, 1985). Furthermore, they have the greatest potential exposure to environmental sources of Pb (i.e., dust, soil Pb) due to greater hand to mouth activity. These factors dictate that any soil Pb level be evaluated with respect to its potential impact on blood Pb levels in children. All of the projections presented in this report are for the 0-6 year old age group.

2.1.4 Relationship Between Soil Pb and Blood Pb

If increases in blood Pb are dramatic due to soil Pb increases, then it is clear that remediation of Pb-containing soils would have great benefit. Conversely, if there is only a weak relationship between soil and blood Pb, then soil remediation would have only minimal impact. This relationship must be determined to judge the efficiency of soil remediation. The ideal way to assess the soil Pb/blood Pb relationship is to survey blood Pb in areas where soil Pb is low and also where it is high, while accounting for other variables that might affect blood Pb.

Since the soil Pb/blood Pb relationship may be site-specific, the blood and soil data should be generated from the area upon which a decision needs to be made (i.e., Granite City). Unfortunately, the previous soil and blood analyses that were done at Granite City are not complete enough to allow this relationship to be evaluated. Specifically, the soil sampling done at Granite City as part of the RI/FS (O'Brien and Gere, 1988) and by the Illinois EPA (1983) focused on the area within one-half mile of the former smelter site. In contrast, the blood Pb data (Illinois Department of Health, 1983) is from the population living within a 2 mile radius of the smelter. Therefore, conclusions about the soil Pb to blood Pb relationship at Granite City should not be based upon these previous studies. Note, however, that the blood Pb results indicate that it is likely that an imminent hazard does not currently exist at Granite City. Further, the study's conclusions would favor a less restrictive remediation standard (Section 4.0).

Another approach is to study the blood Pb/soil Pb relationship at sites that are similar to Granite City, and then to apply these results to Granite City. TRC has done this for a site (Midvale, Utah) for which extensive effort was made to account for all other variables that might affect blood Pb

(Bornschein, 1990). This analysis is presented in Section 3.2. Additionally, other smelter sites have been considered in determination of the most appropriate soil Pb/blood Pb relationship to be used in judging Granite City.

Finally, a very useful method is to develop a mathematical model that predicts the blood Pb concentration at particular soil Pb levels. This model has been termed the Integrated Lead Uptake/Biokinetic Model. It incorporates the major sources of Pb exposure [diet, water, air, soil, house dust (including indoor sources such as Pb paint)] to calculate a population mean blood Pb level. Also, it predicts the population blood Pb distribution so that the percentage of individuals having blood Pb levels above a particular cutoff (e.g., 15 µg/dl) can be determined. It relies upon known or estimated values for the parameters which describe the different exposure routes. However, in certain cases, the parameter values are not clearly defined, which can introduce large uncertainties and errors into the predictions about blood Pb. Therefore, it is essential that the model be validated against actual field data. EPA has conducted a validation exercise with this model (EPA, OAQPS, 1989) which pointed out that adjustments are necessary in the percent Pb absorption from soil. However, the EPA has not refined this analysis, nor have they used the information from the validation exercise in applying the model to Granite City. In a previous validation exercise by TRC, it was found that a better fit of the model to actual blood Pb data could be achieved by adjusting the parameters that describe soil Pb exposure (Hoffnagle, 1987 - Appendix 3). In the current analysis we have conducted another validation exercise, using a relatively complete data set from a former smelter and milling site (Midvale, Utah) (Bornschein, 1990). Again, we found that by adjustment of the soil Pb parameters, a better fit to the actual blood Pb data was achieved. The conclusions drawn from this validation were confirmed by comparison to 4 other smelter sites. We next drew upon these previous and current validation experiences to fine tune the model and apply it to the Granite City site. Thus, the current analysis utilizes a version of the Uptake/Biokinetic Model that is much better able to predict the relationship between soil Pb and blood Pb, than is that used by EPA for Granite City. These differences are elaborated upon in Section 3.

2.2 Uptake/Biokinetic Model: Parameters That Determine the Importance of Different Pb Sources

2.2.1 Dietary Pb

The amount of Pb ingested in the diet on a daily basis is based upon Pb levels in food and dietary patterns in children of different ages. Dietary Pb ingestion has decreased 3-fold in the past 8-10 years (Table 1), due largely to the phase-out of leaded gasoline and the removal of lead solder from food cans (EPA, OAQPS, 1989). Pb absorption from the diet is considered to be fairly efficient, but decreases with age (Table 2). The average for 0-6 year old children is 39%.

2.2.2 Pb in Drinking Water

The model utilizes the average Pb level in drinking water in the United States (8.88 μg/dl). This value is highly variable on an individual basis due to the presence of lead pipes in some homes, but not in others. The national average level is used unless more specific information is available for the site being modeled. The amount of Pb entering the bloodstream depends upon the volume of water ingested (average value for 0-6 year old children is 0.48 liters/day), and upon the percent absorption of Pb from drinking water (50%).

2.2.3 Airborne Pb

The model incorporates information on average ambient Pb levels, the percent absorption of Pb once inhaled (50%) and the respiration rate of children (4.6 liters/day for 0-6 years old) (Table 2). Ambient Pb makes only a minor direct contribution to blood Pb, but its major effect is indirect by increasing soil and house dust Pb.

2.2.4 Household Dust Pb

The uptake of Pb from household dust depends upon the amount of dust ingested per day. Total dirt (soil plus dust) ingestion in children is highly uncertain. Original estimates were 100 to 200 mg/day (EPA, OAQPS, 1989), but more recent evidence suggests that it could be as low as 30-40 mg/day (Calabrese, 1989). The greater the amount of dirt ingestion, the higher the prediction for blood Pb becomes, if all other variables in the model are held constant. Clearly, modification of this parameter could improve the fit of the model to actual blood Pb levels. However, our validation effort (Section 3.2) and the one conducted by EPA (EPA, OAQPS, 1989) both demonstrated that reduced soil Pb absorption appears to occur at high soil Pb concentrations, whereas dirt ingestion should not be different. Further, there is independent literature support for this concept (see below). Therefore, in our runs of the model for validation purposes and for predicting blood Pb levels for Granite City, we have used EPA's default value for soil ingestion (25 mg/day for <1 year old children, 100mg/day for 1-6 year old children), and instead varied the percent of Pb absorption from soil and dust to achieve the best fit of the model to actual blood Pb data.

The percent absorption of Pb from dirt (soil plus house dust) may be substantial (30%) at low Pb levels, but declines at higher Pb levels (EPA, ECAO, 1986). This is based upon the non-linear relationship between blood Pb and Pb intake across a range of intake levels: as the Pb intake increases, the relative change in blood Pb levels declines (EPA, OAQPS, 1989). This may be explained by increased removal of Pb from the blood or saturation of Pb transport pathways in the gut under conditions of high Pb ingestion. Additionally, Pb absorption from soil can be diminished by the presence of other metals such as zinc, which are also released from smelters and have a similar geographical distribution as does Pb (Bornschein, 1990). Saturation of Pb absorption may thus occur not only because of the limited ability of the gut to absorb Pb, but also because of zinc's interference with Pb absorptive mechanisms in the gut (EPA, ECAO, 1986). Pb absorption values from dust and soil have been derived from runs of the Uptake/Biokinetic Model for the Midvale data set and confirmed by consideration of the data from 4 other smelters. This analysis is presented in Section 3.2.2.

Another factor affecting the importance of household dust Pb in contributing to blood Pb is the ratio of dust to soil ingestion. This ratio is determined by the amount of time children spent outdoors compared to indoors, during which they might be ingesting dirt. As Table 2 shows, on average, very young children spend much less time outdoors than do older children. These values have been adjusted for climactic factors which limit outdoor play time. The average time spent outdoors used in our runs of the model is 2.67 hours per day for 0-6 year old children.

Therefore, the percentage of the 100 mg dirt ingestion that occurs outdoors which can be directly attributable to soil is:

$$\frac{\text{2.67 hours outdoors}}{\text{12 hour period of ingestion}} = 22.3\% \text{ (22.3 mg/day)}$$

GC 107039

Similarly, the percentage of dirt ingestion that can be attributed to household dust is 77.7% (77.7 mg/day).

2.2.5 Pb in Soil

The discussion of Pb intake from household dust applies to Pb intake from soil. However, an additional component of soil Pb ingestion is that which occurs indoors due to entrainment of soil into homes. This factor is small if indoor sources of Pb are substantial (e.g., lead paint), which is likely in many cases since house dust Pb levels are consistently higher than soil Pb levels (Section 2.3.4, Table 3a and 3b).

2.3 EPA Approach and Use of the Uptake/Biokinetic Model for Predicting Granite City Blood Pb Levels

2.3.1 EPA's Goal in Using the Model at Granite City

EPA needed to determine whether a soil Pb level of 1000 ppm would produce an unacceptably high blood Pb level. Further, the Agency needed to determine whether remediation of soil to 500 ppm would result in substantial reduction in blood Pb so as to sufficiently diminish risks for children. EPA utilized the predictions from the Uptake/Biokinetic model as their major rationale for settling upon a 500 ppm soil remediation level.

2.3.2 EPA's Predictions of Granite City Blood Pb Levels

The model output obtained by EPA is summarized in Table 4, Runs 1 and 2. TRC ran the model using the values provided by EPA in their Record of Decision (RoD) for Granite City (Appendix B, 1990), and obtained the same output that they did (Runs 1 and 2). At Pb levels of 1000 ppm in soil and house dust, EPA's inputs to the model yielded unacceptably high blood Pb levels: a predicted population mean of 11.86 µg/dl with 34% of the children having blood

Pb levels greater than 15 μg/dl. Thus, the goal that no more than 5% of the population would have a blood Pb greater than 15 μg/dl was far from realized by this prediction.

EPA then modeled the potential benefit arising from reduction of soil Pb to 500 ppm (Run 1). The model prediction at 500 ppm was below that at 1000 ppm (population mean = 8.37 μg/dl), but still 8.4% of the children were above 15 μg/dl. EPA concluded that these blood levels would be acceptable because future reductions in environmental Pb releases and exposures would further reduce childhood blood Pb. Thus, EPA concluded that soil remediation to 500 ppm is necessary and sufficient to be protective of public health in Granite City.

2.3.3 Key EPA Assumptions Which Led to the Inflation of Blood Pb Predictions

2.3.3.1 Dietary Pb Ingestion

EPA assumed that residents in Granite City in 1990 would be ingesting Pb in their diet at 1982 levels. Since dietary Pb for the period 1990-1996 has been calculated by EPA, Office of Air Quality Planning and Standards (1989), to be only one-third the 1982 level, EPA's use of the older Pb dietary ingestion data is completely inappropriate. By employing the 1982 data, EPA's prediction of Granite City blood Pb is inflated by 25%. This can be seen in Table 4, Run 3, wherein TRC ran the model using all of the values EPA chose for Granite City, except that the dietary data were updated.

2.3.3.2 Pb Absorption from the Diet

The value for Pb absorption from dietary sources used by EPA is 50%. However, this is the value for very young children (<2 years old); dietary Pb absorption decreases beyond this age, with adults being able to absorb only

GC 107041

7-15% of Pb in the diet (EPA. OAQPS. 1989). Since EPA was attempting to predict blood Pb levels for 0-6 year old children, it was inappropriate to use the dietary Pb absorption level that would be experienced by only the very young. Thus, 39% Pb absorption from the diet should have been used instead of 50% (Table 2). Use of the higher Pb absorption value in the model inflated EPA's prediction of Granite City blood Pb levels by 7%.

2.3.3.3 Pb Absorption from Soil and House Dust

EPA assumed that Pb absorption from soil/dust would be 30% at both 500 and 1000 ppm Pb. However, as discussed in Section 2.2.4, EPA recognizes that this value is probably too high at elevated soil Pb levels. EPA has not made a detailed analysis of the relationship between soil Pb and Pb absorbability in the gut, nor have they incorporated lower absorption values in the model. Our analysis in the Midvale data (Section 3.2) demonstrates that Pb absorption from soil/dust is likely to be 19% at 1000 ppm, and 27% at 500 ppm. EPA's use of 30% Pb absorption from soil/dust at 1000 ppm Pb in soil inflates their prediction of blood Pb by 31%.

The net result of EPA's inappropriate use of the model is that childhood blood Pb levels at Granite City were inflated by a total of 52%. Further support for this conclusion is presented in Section 3, where TRC's use of the model is described.

2.3.4 Key EPA Assumptions that Led to the Inflation of the Benefit Derived from Remediating Soil Pb to 500 ppm

2.3.4.1 Soil Pb Absorption

As discussed above, Pb absorption from soil is dependent upon the Pb level in soil. As soil Pb levels decrease, the percent Pb absorption increases. Thus, when dropping soil Pb from 1000 ppm (19% Pb absorption) to 500 ppm (27% Pb absorption), the reduction in actual Pb exposure is partially offset by the increase in Pb absorption. This factor alone decreases the benefit achievable from soil Pb remediation from EPA's estimation of 30% decrease in blood Pb to 19%. (Compare Runs 1 and 2 in Table 4 for EPA's predicted benefit and Runs 4 and 5 for this analysis of remediation benefit.)

2.3.4.2 House Dust/Soil Pb Relationship

EPA assumed that a decrease of soil Pb from 1000 ppm to 500 ppm would also decrease the house dust Pb level to 500 ppm. This is a very optimistic assumption. House dust Pb also comes from indoor sources, such as Pb paint, which would not decrease upon soil lead remediation. In fact, indoor dust Pb levels are consistently higher than outdoor soil Pb levels, as seen in Tables 3a and 3b. These data are from twelve different former or still existing lead smelter sites, which makes for a useful comparison to Granite City. Based upon these data, the more likely indoor dust Pb levels would be 784 ppm after remediation of soils to 500 ppm. When this factor is taken into consideration, together with the increase in lead absorption from soil at 500 ppm the net result would be only a 6% drop in blood Pb levels (Table 4, Run 6). Thus, EPA's use of the Uptake/Biokinetic Model has greatly inflated the efficiency of remediation of soil from 1000 to 500 ppm, and, in fact, it is likely that only a very small benefit could hope to be achieved from such an effort.

3.0 CURRENT USE OF THE MODEL TO EVALUATE BLOOD LEAD LEVELS AT GRANITE CITY

3.1 Improvement of the Uptake/Biokinetic Model by Adjustment of Key Model Parameters

Use of any mathematical model requires adjustment of parameters to reflect model performance compared against actual field data. However, EPA has failed to do this in the case of the Uptake/Biokinetic Model at Granite City. The approach taken by TRC in this analysis was to test the Uptake/Biokinetic Model against actual blood Pb data, using model inputs that adequately reflect the soil, dust, ambient, water and dietary Pb levels at the site being modeled. We chose a very recent and complete data set from a former smelter and milling site, Midvale, Utah, to re-calibrate the model. Additionally, we used previous model validations conducted by TRC (1987) for 4 smelter sites in our appraisal of model parameters. This analysis enabled us to adjust model parameters, most importantly, the soil absorption factor, so that a more realistic prediction could be made for Granite City blood Pb levels. Table 5 summarizes the model parameters used by EPA, and the adjustments to these parameters made by TRC.

3.2 Supporting Evidence for TRC's Adjustments to the Uptake/Biokinetic Model

3.2.1 Use of Up-To-Date Dietary Pb Ingestion Data

A straightforward replacement of 1982 dietary Pb data with the 1990-1996 data updates the Granite City blood lead prediction. The decrease in dietary Pb over the past 8 years has considerably reduced total environmental Pb exposure. Coordinate with this decrease in dietary Pb is a similar decline in average blood lead values over this time period. Therefore, the decline in dietary Pb intake, approximately 3 fold over the past 8 years, is important to factor into the Uptake/Biokinetic Model. Substitution of the current dietary Pb data for the outdated data lowers the Granite City blood lead predictions at 1000 ppm soil content by 32% from EPA's prediction. This reduction is substantial, and is essential to make Granite City predictions realistic.

3.2.2 Downward Correction of Pb Absorption from Soil and House Dust at High Soil Pb Levels

As discussed in Section 2.2.4, it is not scientifically valid to assign a Pb absorption value of 30% to all soil Pb concentrations. Although EPA has recognized that a decrement in absorption from soil is called for, the Agency has not made a systematic evaluation of what the size of this decrement should be. Furthermore, they have not attempted to factor this decrement in absorption into the Uptake/Biokinetic Model.

To correct the absorption parameter in the Uptake/Biokinetic Model, we have compared the model's predicted blood Pb results to actual field data in the case of Midvale, Utah (Bornschein, 1990). This site was chosen for detailed analysis because of the extensive data base available for Midvale which matches blood Pb levels for children to the to the sources of Pb in their immediate environment. Further, as discussed below, Midvale shares some properties with Granite City (e.g., former smelter, high soil Pb levels). This data set was utilized to adjust the model in achieving the best fit to actual blood Pb data. Additionally, confidence in the soil Pb absorption value chosen was obtained by the finding that a similar absorption value achieved the best fit in the case of four other smelter sites.

An important case study for this analysis is the 1989 blood lead data from Midvale, Utah. The Midvale community has been impacted by mining and smelter activities, which have resulted in continued elevated soil Pb levels. This is in spite of the termination of smelting activities in 1958, and mining operations in 1971. A relatively complete data set for this site exists, which incorporates a multi-media environmental Pb analysis (i.e., Pb in paint, house dust, soil and water, behavioral and demographic factors) with matching blood Pb data for 128 children (Bornschein, 1990). Our analysis involved a back calculation of the percent Pb absorption from soil and house dust for each of the records in the Midvale data set. In fact, only 109 of the 128 records were complete enough with respect to data on Pb in soil and in house dust to be suitable for use in the analysis. For a given record, the contribution to blood Pb from dietary (1990-1996 dietary Pb values; 39% Pb absorption from diet), water and ambient Pb sources were totaled, and then subtracted from the actual blood Pb level for that record. The net result was the blood Pb attributable to soil and dust. Then the Pb ingestion from soil and house dust was calculated based upon the soil and house dust Pb levels for that record, and assuming that children ingest 100 mg soil/dust per day.

Finally, Pb absorption from soil/dust was calculated from each record by dividing the blood Pb attributable to soil/dust by Pb ingestion from soil/dust. This analysis was the equivalent of running the Uptake/Biokinetic Model to predict Pb absorption from soil using actual blood Pb data instead of using it to predict blood Pb levels.

The records were divided into groups based upon the soil Pb level (0-250 ppm, 251-500 ppm, 501-750 ppm, 751-1000 ppm, >1000 ppm soil Pb), and the mean Pb absorption from soil/dust for each group was calculated. These results are summarized in Table 6, and the methodology and raw data are presented in Appendix 1.

The results of our analysis, and that of the Midvale report (Bornschein, 1990) demonstrate several points that are very important to the determination of a soil Pb remediation level at Granite City.

3.2.2.1 <u>Soil Pb Absorption Results at Midvale</u>

The Uptake/Biokinetic Model overpredicted blood Pb levels in data sets where soil Pb was elevated above 750 ppm. To achieve a better fit of the model to the actual data, decreases of soil Pb absorption to 16-21% were required (Table 6). The total set of Midvale data did fit the model predictions without the need for adjustment, apparently because of the efficient Pb uptake at low soil Pb concentrations, which compensated for the low uptake at high soil Pb. This analysis dictates that the most appropriate soil Pb absorption value for use in the model is 16-21% at or above 1000 ppm soil Pb. At 500 ppm soil Pb, this absorption value is 27%.

3.2.2.2 Soil Pb/Blood Pb Relationship at Midvale

The Midvale data provides important guidance concerning the appropriate relationship between soil Pb and blood Pb. The overall analysis, as reported by Bornschein, et al., shows that blood Pb increased only 1.25 ug/dl per 1000 ppm increase in soil Pb. Soil Pb levels at Midvale ranged from 69 to 2,352 ppm. The authors speculated that this small increase in blood Pb as soil Pb rises is likely due to impaired soil Pb absorption at higher Pb levels. This speculation was borne out by our runs of the Uptake/Biokinetic Model as depicted in Table 6 and described above. Other researchers have found a similar increment in blood Pb with increases in soil Pb. (Lead Criteria Document, EPA, 1986), except in two cases (Omaha, Nebraska; British Columbia). In these two cases, the blood Pb/soil Pb relationship was studied in areas with high ambient Pb levels (e.g., around operating smelters), which can obscure the true relationship between soil Pb and blood Pb. This is because ambient Pb is a major determinant of both blood Pb and soil Pb, so that both increase markedly with elevations in ambient Pb (EPA, OAQPS, 1989). Once the overriding influence of ambient Pb is diminished (as in Midvale and Granite City), the true relationship between soil Pb and blood Pb can be uncovered. For example, in a study of 2 year old children who had low ambient exposure to Pb (0.28-0.34 ug/m^3), but whose exposure to Pb in the soil varied over a broad range, the mean blood Pb in the group exposed to >10,000 ppm in soil was only 38% higher than the group exposed to <1,000 ppm in soil (Baltrop, 1975). The change in blood Pb was only 0.6 μg/dl per 1,000 ppm change in soil Pb (Lead Criteria Document, EPA, 1986). Thus, the Midvale analysis and the Baltrop study are especially relevant to Granite City, and the small rise in blood Pb with elevations in soil Pb seen in these studies are likely to be a good approximation of the relationship at Granite City.

3.2.2.3 Soil Pb Made Only a Small Contribution to Blood Pb at Midvale

The Midvale study points out the small contribution that soil Pb makes to blood Pb. As shown by Bornschein, et al., Pb in soil made a statistically significant, but very small (3-12%) contribution to blood Pb. Other environmental Pb sources found to contribute to blood Pb at Midvale were lead in house paint and socioeconomic status. Thus, when all possible contributors to blood Pb were included in the analysis, soil Pb was found to be only a small component. However, much of the variability in blood Pb remained unexplained in their analysis, indicating that factors difficult to quantify or account for (e.g., degree of paint peeling within homes) may have also made significant contributions.

These analyses of the Midvale data demonstrate that large changes in soil Pb may lead to only small changes in blood lead, that soil Pb is only a minor contributor to blood Pb, and that soil Pb is poorly absorbed at a soil Pb level of 1000 ppm.

Thus, it is quite reasonable to conclude that soil Pb may have only a minor influence on blood Pb levels at Granite City. To determine this with certainty, a new blood lead survey, incorporating a complete, multi-media Pb exposure analysis is required. However, lacking this badly needed data, the preliminary blood Pb data from Granite City (IEPA, 1983) is instructive in demonstrating the likely effect that soil Pb has on blood Pb at this site.

3.2.2.4 Blood Pb Survey Data From Other Smelters Demonstrate that the Uptake/Biokinetic Model Overpredicts Blood Pb Levels

A previous evaluation of the Uptake/Biokinetic Model conducted by TRC (Hoffnagle, 1987, Appendix 3) employed site-specific inputs into the model for four additional smelter sites (East Helena, Montana, Herculaneum, Missouri, Toronto, Ontario, and Kellogg, Idaho). Actual data for Pb in air, soil, and house dust, and blood Pb survey results were used to calibrate the model. The smelter sites generally had high soil Pb and blood Pb levels, although the data did cover a range of Pb values. When the four data sets were combined, the model was found to overpredict the actual blood Pb results by approximately 40%. Since Pb from soil and dust presented a major route of exposure, and because Pb uptake from these sources involved the greatest degree of uncertainty, the soil/dust contribution to blood Pb was further examined. The soil ingestion value used originally was 100 mg/day, but this value for soil ingestion is controversial. Therefore, this parameter was adjusted to derive a better fit to the actual blood Pb data. The best fit was achieved by changing soil ingestion to 60 mg/day. In the current analysis, we have calibrated the model primarily with respect to percent Pb absorption from soil and dust. This is because of the recent evidence that Pb absorption from soil is likely to decline at high soil Pb (EPA, OAQPS, 1989). Further, the Midvale data described above clearly showed that the soil Pb contribution to blood Pb declined at higher soil Pb levels. Since factors such as amount of soil ingested, should not be materially different between the low and high soil Pb groups, then the reason for this difference is likely to be due to decreased Pb absorption from soil, and not due to decreased soil ingestion.

Instead of calibrating the model with respect to soil ingestion, we have calibrated it with respect to soil Pb absorption. For the four data sets analyzed in 1987, the best fit of the model to the actual blood Pb levels occurs at 18% soil Pb absorption. This is within the range of soil absorption values expected at 1000 ppm based upon the Midvale analysis (16-21%). Therefore, there is a high degree of confidence in the application of a soil Pb absorption value in this range, instead of the EPA default value of 30%.

3.3 Predictions of Granite City Blood Pb Levels Using the "Best-Fit" Up-to-Date Version of the Uptake/Biokinetic Model

Table 4 outlines runs of the model conducted with the "best-fit" model parameters. EPA's runs of the model for Granite City at 500 and 1000 ppm are presented for comparison. The EPA use of the model for Granite City is described in Section 2.3. The goal of the current analysis, like those of EPA, were: a) to evaluate whether 1000 ppm Pb in soil represents a level of concern regarding blood Pb, and b) to evaluate whether decreasing Pb in soil from 1000 to 500 ppm would achieve a substantial benefit. The results of the model runs regarding these 2 points, are discussed below.

If soil and house dust Pb are set to 1000 ppm (Run 4), the predicted mean blood level is 6.47 ug/dl, which is 45% below EPA's prediction, and is very close to the 1990 average blood Pb levels in children not exposed to unusual sources of Pb (e.g., lead-based paint or high lead in drinking water) (4.0-6.0 ug/dl) (Bornschein, 1990). Further, only 1.65% of the population of children in Granite City would be expected to have blood Pb levels above 15 ug/dl. The best available estimate for urban areas is that approximately 7% of the population of children would be above 15 ug/dl (ATSDR, 1988).

Therefore, the predicted blood Pb levels for Granite City are similar to that generally expected in the United States, and the predicted number of children "at risk" (blood Pb > 15 ug/dl) is low compared to that in urban areas.

Even though the analysis at 1000 ppm did not show an adverse impact on blood Pb, the analysis was extended to 500 ppm to evaluate the potential benefit of soil remediation.

If the soil Pb were remediated from 1000 ppm to 500 ppm, a small decrease in blood Pb levels would be realized. This can be seen in Table 4 by comparing Runs 4 and 5. If EPA's assumption that remediating the soil to 500 ppm also reduces house dust Pb to 500 ppm, then a 19% decrease in blood Pb could be expected, while the percentage of children above 15% would be slightly reduced (1.65% to 0.19%). However, as discussed in Section 2.3.4, this assumption does not consider that removing the outdoor soil source of Pb will do nothing to remediate internal sources of Pb (e.g., lead paint). A better approximation of the indoor dust Pb level at a soil Pb level of 500 ppm is 784 ppm (Tables 3a and 3b).

At a soil Pb level of 500 ppm and a house dust Pb of 784 ppm (Run 6), the blood Pb level would be only 6% below the level at 1000 ppm soil, and the percentage above the 15 ug/dl cutoff would not be materially improved. Since this is the run of the Model which incorporates the best available data on the relationship between soil Pb and house dust Pb, this run should be considered the most applicable to the evaluation of soil remediation. The choice by EPA to set the soil and house dust Pb levels to the same value is a gross simplification of the true relationship, and creates a false impression of potential benefit from remediation.

It is noteworthy that the Midvale data set described earlier predicts that a change of 500 ppm in soil Pb would achieve a change in blood Pb of 0.63 ug/dl. For the two "remediation" runs of the model (Runs 5 and 6), the change in blood Pb per decrease of 500 ppm in soil Pb are 1.17 and 0.37 ug/dl, respectively. This comparison supports the current use of the model in developing predictions regarding remediation efficiency.

4.0 <u>COMPARISON OF THE CURRENT BLOOD Pb PREDICTIONS TO THE PREVIOUS BLOOD Pb SURVEYS AT GRANITE CITY</u>

The Uptake/Biokinetic Model has been re-calibrated to reflect the best available data, and confidence in its results comes from comparisons with blood Pb data from other smelter sites, as described above. However, it is best to avoid relying solely on modeled predictions to make judgments concerning soil remediation levels for Pb. Unfortunately, no current blood Pb study at Granite City is available, and this needs to be remedied before any remediation decision is made. However, the previous blood lead survey at Granite City is a very important indicator that elevated blood Pb levels are not to be expected. Further, the blood Pb survey results provide strong support for the conclusions drawn from the runs of the Uptake/Biokinetic Model described above. The survey is described below, together with an analysis of the utility of the study's results given its shortcomings.

The Illinois Department of Public Health (IDPH) conducted a blood Pb and environmental Pb survey in November/December, 1982 on adults and children in Granite City (IEPA, 1983). Blood Pb data were collected on 46 children age six and under; the mean blood Pb level was 10 ug/dl, well within the range of average blood Pb levels reported for the U.S. population by the FDA in 1982 (10-20 ug/dl). Factors that may have affected the results of this study were the low sample size, the fact that samples were taken in the fall rather than the summer, and that the ambient Pb concentrations at the time of survey were below those typical at the site. Based upon these factors, EPA has chosen to disqualify this study. While some criticism of the study is valid, it is important to seriously weigh it in judging the potential health risks at the site.

Although the sample size was small, the results were consistent with two previous studies, which also failed to show an elevation in childhood blood Pb in Granite City. These blood surveys were conducted in 1976 by the Illinois Association for Retarded Citizens, and in 1979 the Illinois Department of Public Health (IEPA, 1983). The assertion by EPA that sampling in the fall will underestimate blood concentrations because exposure is greatest in the summer is gratuitous (EPA, 1988). EPA provided no documentation for this argument, and their own calculation of the percent underestimation of blood lead values (15-20%) would have only a small effect on the results of the survey. Even if the surveyed blood Pb concentrations are adjusted upwards by 20% to correct for sampling in the fall instead of the summer, the blood concentrations of Granite City children would still have been well within the national average range. Finally, the fact that ambient Pb concentrations were lower than "normal" at the time of sampling is not a major confounder. Inhalation exposure is not a major route of Pb exposure in children, and household dust and soil concentrations would not be expected to have decreased substantially during the short period of lower than "normal" ambient concentrations.

Therefore, the study results present a reasonable assessment of the range of blood concentrations that could have been expected at Granite City in 1982, a time in which the smelter was still operational. These results suggest that soil Pb can, at most, have only a minor influence on blood Pb concentration for children at Granite City. The finding of blood Pb concentrations at Granite City that are within normal limits is evidence that the important contributors to blood Pb at this site are similar to those experienced nationally. Thus, background sources of Pb (e.g., Pb paint), may be the most significant contributors to blood Pb at Granite City.

5.0 REFERENCES

Agency for Toxic Substances and Diseases Registry, 1988. The Nature and Extent of Lead Poisoning in Children in the United States: A Report to Congress.

Baltrop, D., Strehlow, C., Thorton, I., and Webb, J. Absorption of Lead From Dust and Soil. Postgraduate Medical Journal 51:801-804.

Bornschein, R., Clark, S., Pan, W. and Succop, P., 1990. Midvale Community Lead Study; Final Report.

Calabrese, E.J., Barnes, R., Stanek, E.J., Pastides, H., Gilbert, C.E., Venaman, P., Wang, X, Lasztity, A. and Kostecki, P.T., 1989. How Much Soil DO Young Children Ingest: An Epidemiologic Study. Regulatory Toxicology and Pharmacology 10:123-137.

Chisholm, J.J., Mellitis, E.D., and Quaskey, S.A., 1985. The Relationship Between the Concentration of Lead Absorption in Children and the Age, Type, and Condition of Housing. Environmental Research 38:31-45.

Cohen, J., Marcus, A., and Elias, R., 1990. Estimating Childhood Multimedia Lead Exposure: Expanded Exposure/Uptake/Biokinetic Model. EPA Document No. 90-12.2 for Presentation at the 83rd Annual Meeting of the Air and Waste Management Association, Pittsburgh, 6/24-6/29, 1990.

Farfel, M.R. 1985. Reducing Lead Exposure in Children. Annual Reviews in Public Health 6:333-360.

Hoffnagle, G.F., 1987. Real World Modeling of Blood-Lead from Environmental Sources. In: Lead in Soil: Issues and Guidelines (Eds. Davies, B.E. and Wixson, B.G.) Science Reviews Ltd., Northwood, pp. 73-93.

Illinois EPA 1983 Study of Lead Pollution in Granite City, Madison, and Venice, Illinois.

O'Brien and Gere, 1988. Remedial Investigation Granite City Site, Granite City, Illinois.

U.S. EPA, Environmental Criteria and Assessment Office, 1986. Air Quality Criteria for Lead, Volume III, Section 11.4.

U.S. EPA, Office of Air Quality Planning and Standards, 1989. Review of the National Ambient Air Quality Standards for Lead: Exposure Analysis Methodology and Validation-OAQPS Staff Report. Lead Study: The Relationship Between Childhood Blood Lead Levels and Environmental Exposure. Journal of the Air Pollution Control Association 27:763-767.

U.S. EPA, 1990. Declaration of Record of Decision: NL Industries/Taracorp; Granite City, Illinois.

GC 107055

TABLES

TABLE 1

AGE-SPECIFIC ESTIMATES OF TOTAL DIETARY LEAD INTAKE

(μg/day)[1]

Age (Years)	1982	1983	1990-1996
<1	21.9	16.3	7.5
1-2	26.0	19.3	8.9
2-3	30.6	24.1	10.4
3-4	30.6	23.0	10.7
4-5	30.7	22.0	10.8
5-6	32.2	23.2	11.3

[1] Table from data supplied by EPA, OAQPS, 1989.

TABLE 2

AGE-SPECIFIC FACTORS USED IN THE UPTAKE/BIOKINETIC MODEL[1]

Parameters	Age Group (Years)						
	<1	1-2	2-3	3-4	4-5	5-6	6-7
Hours spent outdoors	1-2	1-3	2-4	2-5	2-5	2-5	2-5
Ventilation rate (m^3/day)	2-3	3-5	4-5	4-5	5-7	5-7	6-8
GI Absorption Rate (%)	42-53	42-53	30-40	30-40	30-40	30-40	18-24

[1] Data taken from Cohen, 1990.

TABLE 3a

RELATIONSHIP BETWEEN SOIL PB AND HOUSE DUST PB AT VARIOUS AMBIENT PB CONCENTRATIONS[1]

Air Pb Range ($\mu g/m^3$)	ppm-Pb Geometric Mean (N)	
	House Dust	Soil
0 - 0.1	338 (7)	153 (7)
0.1 - 0.3	338 (18)	207 (19)
0.3 - 0.5	850 (11)	477 (12)
0.5 - 1.0	817 (8)	587 (9)
1.0 - 2.0	1643 (5)	1003 (4)
2.0 - 3.0	1917 (8)	975 (8)
>3.0	4358 (7)	2278 (8)

TABLE 3b

RELATIONSHIP BETWEEN SOIL AND HOUSE DUST PB AT VARIOUS RANGES OF SOIL PB[1]

Soil Pb Range (ppm)	ppm-Pb Geometric Mean (N)	
	House Dust	Soil
0 - 250	275 (27)	106 (27)
250 - 500	569 (8)	351 (8)
500 - 1000	1043 (12)	677 (12)
1000 - 2000	2282 (7)	1428 (7)
2000 - 3000	2420 (6)	2500 (6)
> 3000	9513 (6)	6936 (6)

[1] Data were taken from 12 former and existing smelter sites as provided by EPA, 1989 and Hoffnagle, 1987.

GC 107059

GC 107060

TABLE 4

UPTAKE/BIOKINETIC MODEL RUNS FOR GRANITE CITY

Run	Soil Pb	Dust Pb	Other Parameter Changes	Mean Blood Pb	% Above 15 μg/dl
1	500	500	EPA/Granite City[1]	8.37	8.44
2	1000	1000	EPA/Granite City[1]	11.86	34.27
3	1000	1000	Dietary Uptake change for 1990-1996	8.96	11.90
4	1000	1000	1-Dietary: 1990-1996 2-% Absorption from Soil and Dust = 19%	6.47	1.65
5	500	500	1-Dietary: 1990-1996 2-% Absorption Adjusted Soil - 27% Dust - 27%	5.21	0.19
6	500	784[2]	1-Dietary: 1990-1996 2-% Absorption Adjusted Soil - 27% Dust - 23% 3-Dust/Soil relationship[2]	6.01	0.91

[1] Runs 1 and 2 utilized EPA chosen model parameters values for Granite City. The results are the same as those reported by EPA in Appendix B of the Record of Decision for Granite City.

[2] House dust Pb level based upon the relationship between soil and Pb dust as seen at other sites (see Tables 3a and 3b). The greater house dust vs. soil Pb level likely reflects indoor sources.

TABLE 5

KEY UPTAKE/BIOKINETIC MODEL PARAMETERS

Values Used by EPA and by TRC
to Predict Blood Levels at Granite City[1]

	EPA	TRC
Soil Pb level	Variable	Variable
House dust Pb level	Variable	Variable
Ambient Pb level (ug/m^3)	0.26	0.26
Water Pb level (ug/liter)	8.88	8.88
Dietary Pb intake (ug/day) (averaged over first 6 years of life)	29.41[2]	10.21[2]
Pb absorption from diet (%)	50%	39%[2]
Soil ingestion (mg/day)	<1 year old: 25 1-6 year old: 100	<1 year old: 25 1-6 year old: 100
Pb absorption from soil and dust (%)	30% regardless of soil Pb levels	Variable: soil/ dust Pb 1000 ppm: % Absorption = 19% soil/dust Pb 500 ppm % Absorption = 27%
Time of Pb exposure outdoors (hr)	1-5 hours	2.67 hours[2]
Fraction of Pb exposure outdoors	17-33%	22.3%[2]

---

[1] Additional parameters incorporated into the model are volume air respired. % Pb absorption from water; % Pb absorption from air. Conversion factor to transform absorbed Pb to blood Pb. The values used for these parameters by EPA and by TRC are the same.

[2] Value is the average for 0-6 year old children.

TABLE 6

UPTAKE/BIOKINETIC MODEL PREDICTIONS OF LEAD ABSORPTION
FROM SOIL AT DIFFERENT SOIL PB LEVELS.
BASED UPON THE MIDVALE DATA SET

Soil Pb (ppm)		% Soil Pb Absorption	N
0- 250		44	40
251- 500		25	20
501- 750		29	22
750-1000		16	13
< 1000		21	14
	TOTAL SITE	32	109

GC 107062

APPENDIX 1

ADJUSTMENT OF THE UPTAKE/BIOKINETIC MODEL SOIL PB ABSORPTION PARAMETER BY CALIBRATION OF THE MODEL AGAINST THE MIDVALE, UTAH DATA SET

Table A-1 is a display of all the records in the Midvale Data Set for children as reported by Bornschein, et al. (1990). For each record, the percent Pb absorption from soil/house dust has been calculated on a Lotus spreadsheet. Definitions for column headings and equations used in this analysis are as follows:

1. Observation: As recorded by Bornschein, et al.
2. Age: Years of age of subject.
3. Soil Pb: Mean soil Pb level around the exterior of the subject's home, including yard, house perimeter, garden and exterior dust Pb levels.
4. Dust Pb: House dust Pb level.
5. Blood Pb Air: The contribution to blood Pb that can be assigned to airborne Pb as calculated by:

   $$\text{Blood Pb Air} = (\text{Pb Air})\,(\text{Respiration Rate})\,(\%\ \text{Pb Absorption from Air})\,(C_{Blood})$$

   where:

   Pb Air = Ambient Pb level. For Midvale it is assumed to be 0.20 $\mu g/m^3$

   Respiration Rate = 4.6 liters/day for 0 to 6-year-old children

   % Pb Absorption from Air = 50%

   C_{Blood} = Factor to convert absorbed Pb (μg) to blood Pb (μg/dl) = 0.287

6. Blood Pb Diet: The contribution to blood Pb that can be attributed to dietary Pb. Estimates for 1990-1996 dietary Pb were used to calculate Blood Pb Diet by:

   $$(\text{Mean Dietary Pb})\,(\text{Pb Absorption from Diet})\,(C_{Blood})$$

where:

Mean Dietary Pb Ingestion (0 to 6-year-old) = 10.21 μg/day

Pb Absorption from Diet = 39%

C_{Blood} as described above.

7. Blood Pb Water: The contribution to blood Pb that can be attributed to Pb in water as calculated by:

(Pb Water) (Pb Absorption from Water) (Water Ingestion/Day) (C_{Blood})

where:

Pb Water = 8.88 μg/liter for the national average Pb level in water

Pb Absorption from Water = 50%

Water Ingestion/Day = 0.48 liters/day for 0 to 6-year-old children

C_{Blood} as described above

8. Total Non-Dirt Blood Pb: The contribution to blood Pb then can be attributed to diet, water and air as calculated by:

(Blood Pb Air) + (Blood Pb Diet) + (Blood Pb Water)

9. Actual Blood Pb: Data for each record taken from Bornschein, et al. data set.

10. Blood Pb Soil and Dust: The contribution to blood Pb that could be attributed to soil/dust as calculated by:

(Actual Blood Pb) - (Total Non-Dirt Blood Pb)

11. Blood Pb Soil + Dust Ingestion (100 mg): The blood Pb contribution that could be attributed4d to soil/dust assuming 100 mg soil ingestion and 100% absorption of Pb from soil/dust as calculated by:

(T.W.A. Soil/Dust Pb) (0.1 Gram Soil Ingestion) (C_{Blood})

where:

T.W.A. Soil/Dust Pb = The time-weighted average for soil/dust Pb in ppm, based upon 2.67 hours of outdoor Pb exposure and 9.33 indoor Pb exposure

12. % Absorption Soil/Dust (100 mg ingestion): The percentage Pb absorption from soil and house dust, assuming 100 mg soil ingestion/day, as calculated by:

Blood Pb Soil + Dust ÷ Blood Pb Soil + Dust Ingestion

where:

Blood Pb Soil + Dust = Parameter #10 described above

Blood Pb Soil + Dust Ingestion = Parameter #11 described above

Table A-2 nests the records by soil Pb level, placing them into either the 0-250, 251-500, 501-750, 751-1000 or > 1000 ppm group. The average absorption of soil Pb for each group was then calculated. Records in which soil Pb or dust Pb levels were missing are excluded. For records with negative soil Pb absorption values, a value of 0 was used.

TABLE A-1
RIOVALE HOUSE DUST, SOIL AND BLOOD LEAD DATA
CALCULATED PERCENT LEAD ABSORBTION FROM SOIL AND DUST
ORIGINAL DATA SET

OBSERVATION (#)	AGE (years)	SOIL Pb (ppm)	DUST Pb (ppm)	BLOOD Pb AIR	BLOOD Pb DIET	BLOOD Pb WATER	TOTAL NON-DIRT BLOOD Pb	ACTUAL BLOOD Pb	BLOOD Pb SOIL + DUST	BLOOD Pb SOIL + DUST INGESTION(100mg)	% ABSORPTION SOIL/DUST (100mg ingest)
1.00	1.20	974.00	718.00	0.18	1.14	0.61	1.93	9.00	7.07	22.44	0.31
2.00	1.75	911.00	590.00	0.18	1.14	0.61	1.93	3.00	1.07	19.41	0.00
3.00	2.10	936.00	1110.00	0.18	1.14	0.61	1.93	5.50	3.57	30.61	0.12
4.00	1.83	620.67	249.00	0.18	1.14	0.61	1.93	2.50	0.57	9.81	0.00
5.00	3.00	489.00	541.00	0.18	1.14	0.61	1.93	5.50	3.57	15.15	0.24
6.00	1.83	562.20	363.00	0.18	1.14	0.61	1.93	8.00	6.07	11.85	0.51
7.00	1.83	440.00	341.00	0.18	1.14	0.61	1.93	9.00	7.07	10.50	0.67
8.00	5.42	528.25	466.00	0.18	1.14	0.61	1.93	6.50	4.57	13.82	0.33
9.00	5.25	535.00	1263.00	0.18	1.14	0.61	1.93	4.50	2.57	31.02	0.08
10.00	1.50	646.50	474.00	0.18	1.14	0.61	1.93	3.00	1.07	14.84	0.00
11.00	1.42	1391.00	1196.00	0.18	1.14	0.61	1.93	6.00	4.07	35.72	0.11
12.00	2.00	464.25	640.00	0.18	1.14	0.61	1.93	8.50	6.57	17.11	0.38
13.00	1.17	371.00	390.00	0.18	1.14	0.61	1.93	5.50	3.57	11.06	0.32
14.00	4.58	747.00	692.00	0.18	1.14	0.61	1.93	9.00	7.07	20.26	0.35
15.00	1.00	872.00	1067.00	0.18	1.14	0.61	1.93	6.00	4.07	29.22	0.14
16.00	1.83	999.00	617.00	0.18	1.14	0.61	1.93	6.00	4.07	20.45	0.20
17.00	3.33	1680.50	1343.00	0.18	1.14	0.61	1.93	15.50	13.57	40.97	0.33
18.00	3.50	990.00	3602.00	0.18	1.14	0.61	1.93	2.00	0.07	84.64	0.00
19.00	3.58	1148.00	567.00	0.18	1.14	0.61	1.93	16.50	14.57	20.44	0.71
20.00	5.67	295.00	340.00	0.18	1.14	0.61	1.93	4.00	2.07	9.44	0.22
21.00	1.25	735.00	509.00	0.18	1.14	0.61	1.93	6.00	4.07	16.23	0.25
22.00	1.50	768.00	475.00	0.18	1.14	0.61	1.93	7.00	5.07	15.73	0.32
23.00	5.92	1761.75	651.00	0.18	1.14	0.61	1.93	5.50	3.57	26.65	0.13
24.00	4.33	817.00	1037.00	0.18	1.14	0.61	1.93	7.50	5.57	28.18	0.20
25.00	1.17	-	517.00	0.18	1.14	0.61	1.93	5.50	3.57	11.13	0.32
26.00	1.92	-	265.00	0.18	1.14	0.61	1.93	8.00	6.07	5.70	1.06
27.00	1.33	1596.50	736.00	0.18	1.14	0.61	1.93	3.00	1.07	27.30	0.00
28.00	4.00	351.00	540.00	0.18	1.14	0.61	1.93	7.00	5.07	14.14	0.36
29.00	4.67	350.50	588.00	0.18	1.14	0.61	1.93	1.50	-0.43	15.17	0.00
30.00	0.83	351.00	1138.00	0.18	1.14	0.61	1.93	7.00	5.07	27.01	0.19
31.00	4.17	2351.50	756.00	0.18	1.14	0.61	1.93	8.00	6.07	33.14	0.18
32.00	1.92	1230.00	758.00	0.18	1.14	0.61	1.93	10.50	8.57	25.14	0.34
33.00	3.33	-	557.00	0.18	1.14	0.61	1.93	5.00	3.07	11.99	0.26
34.00	2.58	-	430.00	0.18	1.14	0.61	1.93	6.00	4.07	9.43	0.43
35.00	4.50	-	422.00	0.18	1.14	0.61	1.93	18.00	16.07	9.08	1.77
36.00	3.67	-	641.00	0.18	1.14	0.61	1.93	4.00	2.07	13.80	0.15
37.00	2.17	-	459.00	0.18	1.14	0.61	1.93	4.00	2.07	9.88	0.21
38.00	2.33	-	511.00	0.18	1.14	0.61	1.93	6.00	4.07	11.00	0.37
39.00	4.08	1301.00	1605.00	0.18	1.14	0.61	1.93	13.00	11.07	43.08	0.25
40.00	1.08	1659.00	1313.00	0.18	1.14	0.61	1.93	5.50	3.57	40.17	0.09
41.00	4.58	756.00	658.00	0.18	1.14	0.61	1.93	7.50	5.57	19.59	0.28
42.00	0.83	287.75	-	0.18	1.14	0.61	1.93	6.00	4.07	2.06	1.97
43.00	3.33	723.00	513.00	0.18	1.14	0.61	1.93	3.00	1.07	16.23	0.00
44.00	1.17	723.00	292.00	0.18	1.14	0.61	1.93	10.00	8.07	11.47	0.70
45.00	1.92	1015.50	926.00	0.18	1.14	0.61	1.93	3.50	1.57	27.22	0.06
46.00	5.58	876.00	605.00	0.18	1.14	0.61	1.93	4.00	2.07	19.31	0.11
47.00	1.08	876.00	603.00	0.18	1.14	0.61	1.93	3.50	1.57	19.26	0.08
48.00	1.67	876.00	678.00	0.18	1.14	0.61	1.93	6.00	4.07	20.88	0.19
49.00	2.92	445.25	-	0.18	1.14	0.61	1.93	6.00	4.07	3.19	1.27

GC 107066

TABLE A-1 (continued)
MIDVALE HOUSE DUST, SOIL AND BLOOD LEAD DATA
CALCULATED PERCENT LEAD ABSORBTION FROM SOIL AND DUST
ORIGINAL DATA SET

50.00	5.17	595.00	-	0.18	1.14	0.61	1.93	4.50	2.57	4.27	0.
51.00	0.58	721.75	1375.00	0.18	1.14	0.61	1.93	3.50	1.57	34.78	0.
52.00	3.92	-	523.00	0.18	1.14	0.61	1.93	5.50	3.57	11.26	0.
53.00	3.33	-	208.00	0.18	1.14	0.61	1.93	6.50	4.57	4.48	1.
54.00	1.00	-	724.00	0.18	1.14	0.61	1.93	5.50	3.57	15.58	0.
55.00	3.17	-	1301.00	0.18	1.14	0.61	1.93	13.00	11.07	28.00	0.
56.00	2.50	357.25	1177.00	0.18	1.14	0.61	1.93	4.50	2.57	27.90	0.[illegible]
57.00	1.58	357.25	873.00	0.18	1.14	0.61	1.93	16.50	14.57	21.35	0.[illegible]
58.00	0.67	711.75	253.00	0.18	1.14	0.61	1.93	8.50	6.57	10.55	0.[illegible]
59.00	4.42	393.00	-	0.18	1.14	0.61	1.93	2.00	0.07	2.82	0.[illegible]
60.00	3.17	393.00	787.00	0.18	1.14	0.61	1.93	4.00	2.07	19.76	0.1
61.00	0.67	1009.40	831.00	0.18	1.14	0.61	1.93	13.50	11.57	25.13	0.4
62.00	2.67	1009.40	-	0.18	1.14	0.61	1.93	13.00	11.07	7.24	1.3
63.00	4.83	1009.40	2274.00	0.18	1.14	0.61	1.93	5.00	3.07	56.19	0.8
64.00	3.92	1727.00	1138.00	0.18	1.14	0.61	1.93	5.00	3.07	36.89	0.0
65.00	2.75	637.00	412.00	0.18	1.14	0.61	1.93	14.50	12.57	13.44	0.9
66.00	2.08	550.00	568.00	0.18	1.14	0.61	1.93	6.50	4.57	16.17	0.2
67.00	0.67	342.00	237.00	0.18	1.14	0.61	1.93	4.50	2.57	7.56	0.3
68.00	1.42	527.67	559.00	0.18	1.14	0.61	1.93	4.50	2.57	15.82	0.1[illegible]
69.00	1.50	527.67	296.00	0.18	1.14	0.61	1.93	7.00	5.07	10.16	0.5[illegible]
70.00	0.67	527.67	293.00	0.18	1.14	0.61	1.93	5.50	3.57	10.09	0.3[illegible]
71.00	3.50	527.67	347.00	0.18	1.14	0.61	1.93	4.00	2.07	11.26	0.1[illegible]
72.00	3.50	527.67	425.00	0.18	1.14	0.61	1.93	9.00	7.07	12.93	0.55
73.00	2.33	380.00	236.00	0.18	1.14	0.61	1.93	4.00	2.07	7.81	0.26
74.00	5.33	380.50	346.00	0.18	1.14	0.61	1.93	6.00	4.07	10.18	0.40
75.00	2.00	632.00	532.00	0.18	1.14	0.61	1.93	7.00	5.07	15.99	0.32
76.00	2.58	512.75	514.00	0.18	1.14	0.61	1.93	4.00	2.07	14.74	0.14
77.00	5.50	187.00	253.00	0.18	1.14	0.61	1.93	3.50	1.57	6.79	0.23
78.00	5.58	187.00	230.00	0.18	1.14	0.61	1.93	2.00	0.07	6.29	0.00
79.00	4.17	187.00	218.00	0.18	1.14	0.61	1.93	6.50	4.57	6.03	0.76
80.00	4.08	187.00	212.00	0.18	1.14	0.61	1.93	7.50	5.57	5.91	0.94
81.00	2.25	187.00	124.00	0.18	1.14	0.61	1.93	8.00	6.07	4.01	1.51
82.00	4.08	190.00	201.00	0.18	1.14	0.61	1.93	5.00	3.07	5.69	0.54
83.00	1.17	366.00	336.00	0.18	1.14	0.61	1.93	3.50	1.57	9.06	0.16
84.00	2.08	366.00	410.00	0.18	1.14	0.61	1.93	3.00	1.07	11.45	0.00
85.00	0.92	366.00	412.00	0.18	1.14	0.61	1.93	5.50	3.57	11.49	0.31
86.00	3.17	507.33	756.00	0.18	1.14	0.61	1.93	2.00	0.07	19.91	0.00
87.00	4.58	1078.00	485.00	0.18	1.14	0.61	1.93	5.00	3.07	18.17	0.17
88.00	3.67	158.67	395.00	0.18	1.14	0.61	1.93	2.00	0.07	9.64	0.00
89.00	1.92	514.67	280.00	0.18	1.14	0.61	1.93	3.00	1.07	9.72	0.00
90.00	2.50	243.00	259.00	0.18	1.14	0.61	1.93	5.00	3.07	7.32	0.42
91.00	2.25	181.40	511.00	0.18	1.14	0.61	1.93	6.00	4.07	12.30	0.33
92.00	4.92	212.00	294.00	0.18	1.14	0.61	1.93	2.00	0.07	7.85	0.00
93.00	0.92	420.00	342.00	0.18	1.14	0.61	1.93	3.50	1.57	10.38	0.15
94.00	2.25	206.50	388.00	0.18	1.14	0.61	1.93	2.50	0.57	9.83	0.00
95.00	0.50	239.33	265.00	0.18	1.14	0.61	1.93	5.00	3.07	7.42	0.41
96.00	2.83	180.00	254.00	0.18	1.14	0.61	1.93	5.50	3.57	6.76	0.53
97.00	0.75	238.50	407.00	0.18	1.14	0.61	1.93	6.00	4.07	10.47	0.39
98.00	5.17	207.00	226.00	0.18	1.14	0.61	1.93	4.00	2.07	6.35	0.33
99.00	3.50	370.00	439.00	0.18	1.14	0.61	1.93	3.00	1.07	12.10	0.00
100.00	2.58	174.00	-	0.18	1.14	0.61	1.93	5.00	3.07	1.25	2.46
101.00	4.25	111.60	186.00	0.18	1.14	0.61	1.93	4.00	2.07	4.80	0.43
102.00	0.58	247.00	343.00	0.18	1.14	0.61	1.93	0.50	-1.43	9.16	0.00
103.00	2.50	126.00	239.00	0.18	1.14	0.61	1.93	5.50	3.57	6.05	0.59
104.00	0.58	144.00	-	0.18	1.14	0.61	1.93	3.00	1.07	1.03	0.00
105.00	4.42	127.75	414.00	0.18	1.14	0.61	1.93	4.00	2.07	9.83	0.21
106.00	4.50	144.40	183.00	0.18	1.14	0.61	1.93	4.50	2.57	4.98	0.52
107.00	2.58	159.00	214.00	0.18	1.14	0.61	1.93	2.50	0.57	5.75	0.00
108.00	2.42	165.80	244.00	0.18	1.14	0.61	1.93	2.50	0.57	6.44	0.00

TABLE A-1 (continued)
MIDVALE HOUSE DUST, SOIL AND BLOOD LEAD DATA
CALCULATED PERCENT LEAD ABSORBTION FROM SOIL AND DUST
ORIGINAL DATA SET

109.00	5.92	895.00	459.00	0.18	1.14	0.61	1.93	4.00	2.07	16.30	0.13
110.00	1.75	117.67	340.00	0.18	1.14	0.61	1.93	5.50	3.57	8.16	0.44
111.00	4.00	242.00	271.00	0.18	1.14	0.61	1.93	8.50	6.57	7.57	0.87
112.00	2.75	270.50	449.00	0.18	1.14	0.61	1.93	3.50	1.57	11.61	0.13
113.00	0.58	232.00	210.00	0.18	1.14	0.61	1.93	1.00	-0.93	6.18	0.00
114.00	5.25	115.25	287.00	0.18	1.14	0.61	1.93	2.50	0.57	7.00	0.00
115.00	4.00	103.00	336.00	0.18	1.14	0.61	1.93	5.50	3.57	7.97	0.45
116.00	2.42	109.67	146.00	0.18	1.14	0.61	1.93	3.00	1.07	3.93	0.00
117.00	4.25	171.00	192.00	0.18	1.14	0.61	1.93	5.00	3.07	5.36	0.57
118.00	4.92	123.00	314.00	0.18	1.14	0.61	1.93	6.00	4.07	7.64	0.53
119.00	2.00	226.00	207.00	0.18	1.14	0.61	1.93	4.50	2.57	6.08	0.42
120.00	2.08	123.00	227.00	0.18	1.14	0.61	1.93	12.00	10.07	5.77	1.74
121.00	4.58	93.00	226.00	0.18	1.14	0.61	1.93	5.00	3.07	5.53	0.55
122.00	2.33	116.00	394.00	0.18	1.14	0.61	1.93	3.50	1.57	9.31	0.17
123.00	0.67	116.00	277.00	0.18	1.14	0.61	1.93	1.50	-0.43	6.79	0.00
124.00	4.00	118.67	119.00	0.18	1.14	0.61	1.93	5.00	3.07	3.41	0.90
125.00	0.58	177.00	149.00	0.18	1.14	0.61	1.93	3.00	1.07	4.48	0.00
126.00	3.25	151.00	285.00	0.18	1.14	0.61	1.93	7.50	5.57	7.22	0.77
127.00	2.50	69.00	245.00	0.18	1.14	0.61	1.93	5.50	3.57	5.77	0.62
128.00	5.58	74.00	206.00	0.18	1.14	0.61	1.93	8.50	6.57	4.97	1.32

GC 107068

TABLE A-2
KIDVALE HOUSE DUST, SOIL AND BLOOD LEAD DATA
CALCULATED PERCENT LEAD ABSORBTION FROM SOIL AND DUST
SORTED BY GROUPINGS OF SOIL LEAD CONCENTRATION

OBSERVATION (#)	AGE (years)	SOIL Pb (ppm)	DUST Pb (ppm)	BLOOD Pb AIR	BLOOD Pb DIET	BLOOD Pb WATER	TOTAL NON-DIRT BLOOD Pb	ACTUAL BLOOD Pb	NET BLOOD Pb SOIL + DUST	BLOOD Pb SOIL + DUST INGESTION(100mg)	% ABSORPTION SOIL/DUST (100mg ingest)	% AVERAG Pb ABSORBT (100mg ing
53.00	3.33	-	208.00	0.18	1.14	0.61	1.93	6.50	4.57	4.48	1.02	
35.00	4.50	-	422.00	0.18	1.14	0.61	1.93	18.00	16.07	9.08	1.77	
55.00	3.17	-	1301.00	0.18	1.14	0.61	1.93	13.00	11.07	28.00	0.40	
36.00	3.67	-	641.00	0.18	1.14	0.61	1.93	4.00	2.07	13.80	0.15	
52.00	3.92	-	523.00	0.18	1.14	0.61	1.93	5.50	3.57	11.26	0.32	
37.00	2.17	-	459.00	0.18	1.14	0.61	1.93	4.00	2.07	9.88	0.21	
54.00	1.00	-	724.00	0.18	1.14	0.61	1.93	5.50	3.57	15.58	0.23	
25.00	1.17	-	517.00	0.18	1.14	0.61	1.93	5.50	3.57	11.13	0.32	
34.00	2.58	-	438.00	0.18	1.14	0.61	1.93	6.00	4.07	9.43	0.43	
33.00	3.33	-	557.00	0.18	1.14	0.61	1.93	5.00	3.07	11.99	0.26	
26.00	1.92	-	265.00	0.18	1.14	0.61	1.93	8.00	6.07	5.70	1.06	
38.00	2.33	-	511.00	0.18	1.14	0.61	1.93	6.00	4.07	11.00	0.37	
127.00	2.50	69.00	245.00	0.18	1.14	0.61	1.93	5.50	3.57	5.77	0.62	
128.00	5.58	74.00	206.00	0.18	1.14	0.61	1.93	8.50	6.57	4.97	1.32	
121.00	4.58	93.00	226.00	0.18	1.14	0.61	1.93	5.00	3.07	5.53	0.55	
115.00	4.00	103.00	336.00	0.18	1.14	0.61	1.93	5.50	3.57	7.97	0.45	
116.00	2.42	109.67	146.00	0.18	1.14	0.61	1.93	3.00	1.07	3.93	0.00	
101.00	4.25	111.60	186.00	0.18	1.14	0.61	1.93	4.00	2.07	4.80	0.43	
114.00	5.25	115.25	287.00	0.18	1.14	0.61	1.93	2.50	0.57	7.00	0.00	
123.00	0.67	116.00	277.00	0.18	1.14	0.61	1.93	1.50	-0.43	6.79	0.00	
122.00	2.33	116.00	394.00	0.18	1.14	0.61	1.93	3.50	1.57	9.31	0.17	
110.00	1.75	117.67	340.00	0.18	1.14	0.61	1.93	5.50	3.57	8.16	0.44	
124.00	4.00	118.67	119.00	0.18	1.14	0.61	1.93	5.00	3.07	3.41	0.90	
118.00	4.92	123.00	314.00	0.18	1.14	0.61	1.93	6.00	4.07	7.64	0.53	
120.00	2.08	123.00	227.00	0.18	1.14	0.61	1.93	12.00	10.07	5.77	1.74	
103.00	2.50	126.00	239.00	0.18	1.14	0.61	1.93	5.50	3.57	6.05	0.59	
105.00	4.42	127.75	414.00	0.18	1.14	0.61	1.93	4.00	2.07	9.83	0.21	
106.00	4.50	144.40	183.00	0.18	1.14	0.61	1.93	4.50	2.57	4.98	0.52	
126.00	3.25	151.00	285.00	0.18	1.14	0.61	1.93	7.50	5.57	7.22	0.77	
88.00	3.67	158.67	395.00	0.18	1.14	0.61	1.93	2.00	0.07	9.64	0.00	
107.00	2.58	159.00	214.00	0.18	1.14	0.61	1.93	2.50	0.57	5.75	0.00	
108.00	2.42	165.00	244.00	0.18	1.14	0.61	1.93	2.50	0.57	6.44	0.00	
117.00	4.25	171.00	192.00	0.18	1.14	0.61	1.93	5.00	3.07	5.36	0.57	
125.00	0.58	177.00	149.00	0.18	1.14	0.61	1.93	3.00	1.07	4.48	0.00	
96.00	2.83	180.00	254.00	0.18	1.14	0.61	1.93	5.50	3.57	6.76	0.53	
91.00	2.25	181.40	511.00	0.18	1.14	0.61	1.93	6.00	4.07	12.30	0.33	
81.00	2.25	187.00	124.00	0.18	1.14	0.61	1.93	8.00	6.07	4.01	1.51	
78.00	5.58	187.00	230.00	0.18	1.14	0.61	1.93	2.00	0.07	6.29	0.00	
80.00	4.08	187.00	212.00	0.18	1.14	0.61	1.93	7.50	5.57	5.91	0.94	
77.00	5.50	187.00	253.00	0.18	1.14	0.61	1.93	3.50	1.57	6.79	0.23	
79.00	4.17	187.00	218.00	0.18	1.14	0.61	1.93	6.50	4.57	6.03	0.76	
82.00	4.08	190.00	201.00	0.18	1.14	0.61	1.93	5.00	3.07	5.69	0.54	
94.00	2.25	206.50	388.00	0.18	1.14	0.61	1.93	2.50	0.57	9.83	0.00	
98.00	5.17	207.00	226.00	0.18	1.14	0.61	1.93	4.00	2.07	6.35	0.33	
92.00	4.92	212.00	294.00	0.18	1.14	0.61	1.93	2.00	0.07	7.85	0.00	
119.00	2.00	226.00	207.00	0.18	1.14	0.61	1.93	4.50	2.57	6.08	0.42	
113.00	0.58	232.00	210.00	0.18	1.14	0.61	1.93	1.00	-0.93	6.19	0.00	
97.00	0.75	238.50	407.00	0.18	1.14	0.61	1.93	6.00	4.07	10.47	0.39	
95.00	0.50	239.33	265.00	0.18	1.14	0.61	1.93	5.00	3.07	7.42	0.41	
111.00	4.00	242.00	271.00	0.18	1.14	0.61	1.93	8.50	6.57	7.57	0.87	
90.00	2.50	243.00	259.00	0.18	1.14	0.61	1.93	5.00	3.07	7.32	0.42	
102.00	0.58	247.00	343.00	0.18	1.14	0.61	1.93	0.50	-1.43	9.16	0.00	

GC 107069

0.4

TABLE A-2 (continued)
MIDVALE HOUSE DUST, SOIL AND BLOOD LEAD DATA
CALCULATED PERCENT LEAD ABSORPTION FROM SOIL AND DUST
SORTED BY GROUPINGS OF SOIL LEAD CONCENTRATION

112.00	2.75	270.50	449.00	0.18	1.14	0.61	1.93	3.50	1.57	11.61	0.13	
20.00	5.67	295.00	340.00	0.18	1.14	0.61	1.93	4.00	2.07	9.44	0.22	
67.00	0.67	342.00	237.00	0.18	1.14	0.61	1.93	4.50	2.57	7.56	0.34	
29.00	4.67	350.50	588.00	0.18	1.14	0.61	1.93	1.50	-0.43	15.17	0.00	
28.00	4.00	351.00	540.00	0.18	1.14	0.61	1.93	7.00	5.07	14.14	0.36	
30.00	0.83	351.00	1138.00	0.18	1.14	0.61	1.93	7.00	5.07	27.01	0.19	
57.00	1.58	357.25	873.00	0.18	1.14	0.61	1.93	16.50	14.57	21.35	0.68	
56.00	2.50	357.25	1177.00	0.18	1.14	0.61	1.93	4.50	2.57	27.90	0.09	
83.00	1.17	366.00	336.00	0.18	1.14	0.61	1.93	3.50	1.57	9.86	0.16	
85.00	0.92	366.00	412.00	0.18	1.14	0.61	1.93	5.50	3.57	11.49	0.31	
84.00	2.08	366.00	410.00	0.18	1.14	0.61	1.93	3.00	1.07	11.45	0.00	
99.00	3.50	370.00	439.00	0.18	1.14	0.61	1.93	3.00	1.07	12.10	0.00	
13.00	1.17	371.00	390.00	0.18	1.14	0.61	1.93	5.50	3.57	11.06	0.32	
73.00	2.33	380.00	236.00	0.18	1.14	0.61	1.93	4.00	2.07	7.81	0.26	
74.00	5.33	380.50	346.00	0.18	1.14	0.61	1.93	6.00	4.07	10.18	0.40	
60.00	3.17	393.00	787.00	0.18	1.14	0.61	1.93	4.00	2.07	19.76	0.10	
93.00	0.92	420.00	342.00	0.18	1.14	0.61	1.93	3.50	1.57	10.38	0.15	
7.00	1.83	440.00	341.00	0.18	1.14	0.61	1.93	9.00	7.07	10.50	0.67	
12.00	2.00	464.25	640.00	0.18	1.14	0.61	1.93	8.50	6.57	17.11	0.38	
5.00	3.00	489.00	541.00	0.18	1.14	0.61	1.93	5.50	3.57	15.15	0.24	
86.00	3.17	507.33	756.00	0.18	1.14	0.61	1.93	2.00	0.07	19.91	0.00	
76.00	2.58	512.75	514.00	0.18	1.14	0.61	1.93	4.00	2.07	14.74	0.14	
89.00	1.92	514.67	280.00	0.18	1.14	0.61	1.93	3.00	1.07	9.72	0.00	
69.00	1.50	527.67	296.00	0.18	1.14	0.61	1.93	7.00	5.07	10.16	0.50	
72.00	3.50	527.67	425.00	0.18	1.14	0.61	1.93	9.00	7.07	12.93	0.55	
71.00	3.50	527.67	347.00	0.18	1.14	0.61	1.93	4.00	2.07	11.26	0.18	
70.00	0.67	527.67	293.00	0.18	1.14	0.61	1.93	5.50	3.57	10.09	0.35	
68.00	1.42	527.67	559.00	0.18	1.14	0.61	1.93	4.50	2.57	15.82	0.16	
8.00	5.42	528.25	466.00	0.18	1.14	0.61	1.93	6.50	4.57	13.82	0.33	
9.00	5.25	535.00	1263.00	0.18	1.14	0.61	1.93	4.50	2.57	31.02	0.08	
66.00	2.08	550.00	568.00	0.18	1.14	0.61	1.93	6.50	4.57	16.17	0.28	
6.00	1.83	562.20	363.00	0.18	1.14	0.61	1.93	8.00	6.07	11.85	0.51	
4.00	1.83	620.67	249.00	0.18	1.14	0.61	1.93	2.50	0.57	9.81	0.00	
75.00	2.00	632.00	532.00	0.18	1.14	0.61	1.93	7.00	5.07	15.99	0.32	
65.00	2.75	637.00	412.00	0.18	1.14	0.61	1.93	14.50	12.57	13.44	0.94	
10.00	1.50	646.50	474.00	0.18	1.14	0.61	1.93	3.00	1.07	14.84	0.00	
58.00	0.67	711.75	253.00	0.18	1.14	0.61	1.93	8.50	6.57	10.55	0.62	
51.00	0.58	721.75	1375.00	0.18	1.14	0.61	1.93	3.50	1.57	34.78	0.05	
43.00	3.33	723.00	513.00	0.18	1.14	0.61	1.93	3.00	1.07	16.23	0.00	
44.00	1.17	723.00	292.00	0.18	1.14	0.61	1.93	10.00	8.07	11.47	0.70	
21.00	1.25	735.00	509.00	0.18	1.14	0.61	1.93	6.00	4.07	16.23	0.25	
14.00	4.58	747.00	692.00	0.18	1.14	0.61	1.93	9.00	7.07	20.26	0.35	0
41.00	4.58	756.00	658.00	0.18	1.14	0.61	1.93	7.50	5.57	19.59	0.28	
22.00	1.50	768.00	475.00	0.18	1.14	0.61	1.93	7.00	5.07	15.73	0.32	
24.00	4.33	817.00	1037.00	0.18	1.14	0.61	1.93	7.50	5.57	28.18	0.20	
15.00	1.00	872.00	1067.00	0.18	1.14	0.61	1.93	6.00	4.07	29.22	0.14	
46.00	5.58	876.00	605.00	0.18	1.14	0.61	1.93	4.00	2.07	19.31	0.11	
48.00	1.67	876.00	678.00	0.18	1.14	0.61	1.93	6.00	4.07	20.89	0.19	
47.00	1.08	876.00	603.00	0.18	1.14	0.61	1.93	3.50	1.57	19.26	0.08	
109.00	5.92	895.00	659.00	0.18	1.14	0.61	1.93	4.00	2.07	16.30	0.13	
2.00	1.75	911.00	598.00	0.18	1.14	0.61	1.93	3.00	1.07	19.41	0.00	
3.00	2.10	936.00	1110.00	0.18	1.14	0.61	1.93	5.50	3.57	30.61	0.12	
1.00	1.20	974.00	718.00	0.18	1.14	0.61	1.93	9.00	7.07	22.44	0.31	
18.00	3.50	990.00	3602.00	0.18	1.14	0.61	1.93	2.00	0.07	84.64	0.00	
16.00	1.83	999.00	617.00	0.18	1.14	0.61	1.93	6.00	4.07	20.45	0.20	0.

GC 107070

TABLE A-2 (continued)
MIDVALE HOUSE DUST, SOIL AND BLOOD LEAD DATA
CALCULATED PERCENT LEAD ABSORBTION FROM SOIL AND DUST
SORTED BY GROUPINGS OF SOIL LEAD CONCENTRATION

61.00	0.67	1009.40	831.00	0.18	1.14	0.61	1.93	13.50	11.57	25.13	0.46
63.00	4.83	1009.40	2274.00	0.18	1.14	0.61	1.93	5.00	3.07	56.19	0.05
45.00	1.92	1015.50	926.00	0.18	1.14	0.61	1.93	3.50	1.57	27.22	0.06
87.00	4.58	1078.00	485.00	0.18	1.14	0.61	1.93	5.00	3.07	18.17	0.17
19.00	3.58	1148.00	567.00	0.18	1.14	0.61	1.93	16.50	14.57	20.44	0.71
32.00	1.92	1230.00	758.00	0.18	1.14	0.61	1.93	10.50	8.57	25.14	0.34
39.00	4.08	1301.00	1606.00	0.18	1.14	0.61	1.93	13.00	11.07	43.88	0.25
11.00	1.42	1391.00	1196.00	0.18	1.14	0.61	1.93	6.00	4.07	35.72	0.11
27.00	1.33	1596.50	736.00	0.18	1.14	0.61	1.93	3.00	1.07	27.30	0.00
40.00	1.08	1659.00	1313.00	0.18	1.14	0.61	1.93	5.50	3.57	40.17	0.09
17.00	3.33	1680.50	1343.00	0.18	1.14	0.61	1.93	15.50	13.57	40.97	0.33
64.00	3.92	1727.00	1138.00	0.18	1.14	0.61	1.93	5.00	3.07	36.89	0.08
23.00	5.92	1761.75	651.00	0.18	1.14	0.61	1.93	5.50	3.57	26.65	0.13
31.00	4.17	2351.50	756.00	0.18	1.14	0.61	1.93	8.00	6.07	33.14	0.18

GC 107071

APPENDIX 2

RUNS OF THE CORRECTED UPTAKE/BIOKINETIC MODEL
TO PREDICT GRANITE CITY BLOOD PB LEVELS

EPA's preliminary version of the Uptake/Biokinetic Model for LEAD Software (Version 0.3, March 1990) was used to obtain predictions of Granite City blood Pb levels. EPA default values for parameters were altered as shown in Tables 4 and 5 for Runs 1-6. The output for Runs 1-6 follow. Tables 4 and 5 are reproduced in this Appendix as a guide to the parameters used in each run.

GC 107072

GC 107073

TABLE 4

UPTAKE/BIOKINETIC MODEL RUNS FOR GRANITE CITY

Run	Soil Pb	Dust Pb	Other Parameter Changes	Mean Blood Pb	% Above 15 µg/dl
1	500	500	EPA/Granite City[1]	8.37	8.44
2	1000	1000	EPA/Granite City[1]	11.86	34.27
3	1000	1000	Dietary Uptake change for 1990-1996	8.96	11.90
4	1000	1000	1-Dietary: 1990-1996 2-% Absorption from Soil and Dust = 19%	6.47	1.65
5	500	500	1-Dietary: 1990-1996 2-% Absorption Adjusted Soil - 27% Dust - 27%	5.21	0.19
6	500	784[2]	1-Dietary: 1990-1996 2-% Absorption Adjusted Soil - 27% Dust - 23% 3-Dust/Soil relationship[2]	6.01	0.91

[1] Runs 1 and 2 utilized EPA chosen model parameters values for Granite City. The results are the same as those reported by EPA in Appendix B of the Record of Decision for Granite City.

[2] House dust Pb level based upon the relationship between soil and Pb dust as seen at other sites (see Tables 3a and 3b). The greater house dust vs. soil Pb level likely reflects indoor sources.

TABLE 5

KEY UPTAKE/BIOKINETIC MODEL PARAMETERS

Values Used by EPA and by TRC
to Predict Blood Levels at Granite City[1]

	EPA	TRC
Soil Pb level	Variable	Variable
House dust Pb level	Variable	Variable
Ambient Pb level (ug/m^3)	0.26	0.26
Water Pb level (ug/liter)	8.88	8.88
Dietary Pb intake (ug/day) (averaged over first 6 years of life)	29.41[2]	10.21[2]
Pb absorption from diet (%)	50%	39%[2]
Soil ingestion (mg/day)	<1 year old: 25 1-6 year old: 100	<1 year old: 25 1-6 year old: 100
Pb absorption from soil and dust (%)	30% regardless of soil Pb levels	Variable: soil/ dust Pb 1000 ppm: % Absorption = 19% soil/dust Pb 500 ppm % Absorption = 27%
Time of Pb exposure outdoors (hr)	1-5 hours	2.67 hours[2]
Fraction of Pb exposure outdoors	17-33%	22.3%[2]

[1] Additional parameters incorporated into the model are volume air respired, % Pb absorption from water; % Pb absorption from air, Conversion factor to transform absorbed Pb to blood Pb. The values used for these parameters by EPA and by TRC are the same.

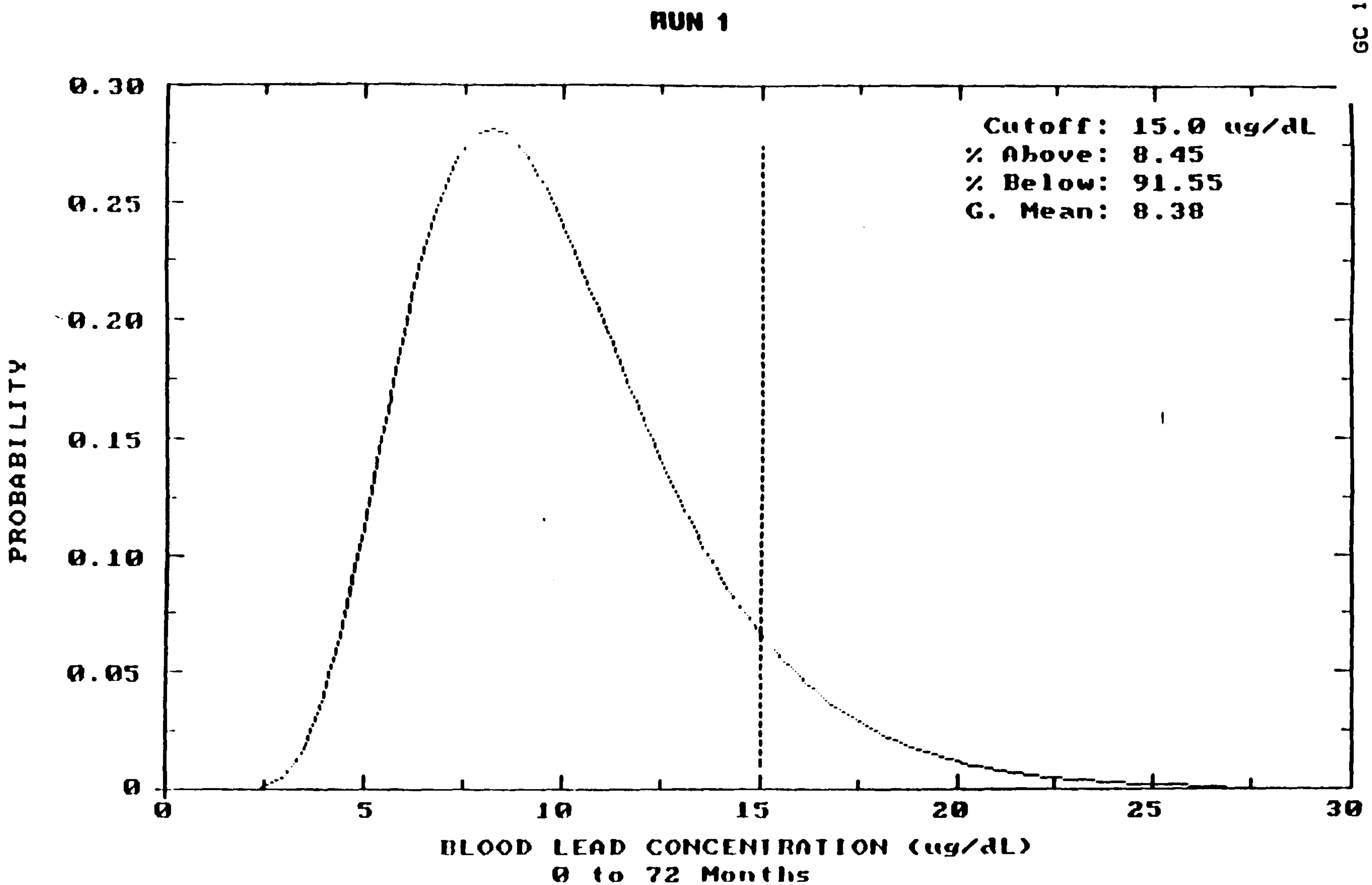
[2] Value is the average for 0-6 year old children.

RUN 1

YEAR	Blood Level (ug/dL)	Total Uptake (ug/day)	Soil+Dust Uptake (ug/day)
0.5-1:	5.13	15.73	3.75
1-2:	7.50	30.43	14.99
2-3:	8.79	32.05	14.99
3-4:	9.22	32.24	14.98
4-5:	9.66	32.54	14.97
5-6:	9.83	33.58	14.96
6-7:	10.01	35.09	14.95

YEAR	Diet Uptake (ug/day)	Water Uptake (ug/day)	Paint Uptake (ug/day)	Air Uptake (ug/day)
0.5-1:	10.93	0.89	0.00	0.17
1-2:	12.96	2.22	0.00	0.25
2-3:	14.33	2.31	0.00	0.42
3-4:	14.49	2.35	0.00	0.42
4-5:	14.71	2.44	0.00	0.42
5-6:	15.45	2.58	0.00	0.58
6-7:	16.94	2.62	0.00	0.58

GC 107076


RUN 1
Cutoff: 15.0 ug/dL
% Above: 8.45
% Below: 91.55
G. Mean: 8.38
PROBABILITY
0.30
0.25
0.20
0.15
0.10
0.05
0
5
10
15
20
25
30
BLOOD LEAD CONCENTRATION (ug/dL)
0 to 72 Months

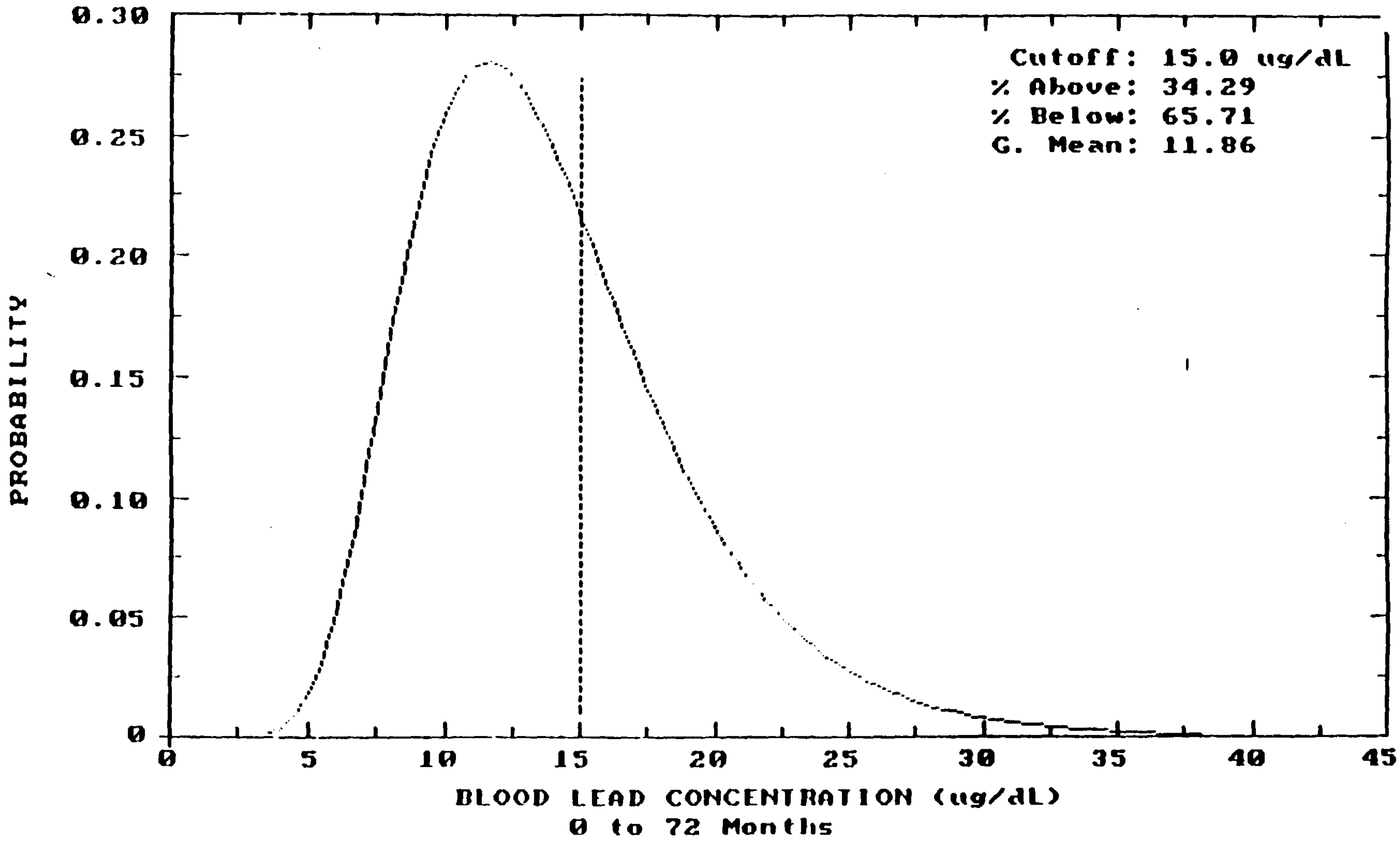
RUN 2

YEAR	Blood Level (ug/dL)	Total Uptake (ug/day)	Soil+Dust Uptake (ug/day)
0.5-1:	6.21	19.48	7.50
1-2:	10.68	45.33	29.90
2-3:	12.08	46.88	29.83
3-4:	13.47	46.99	29.73
4-5:	14.07	47.17	29.60
5-6:	14.20	48.05	29.44
6-7:	14.28	49.38	29.24

YEAR	Diet Uptake (ug/day)	Water Uptake (ug/day)	Paint Uptake (ug/day)	Air Uptake (ug/day)
0.5-1:	10.93	0.89	0.00	0.17
1-2:	12.96	2.22	0.00	0.25
2-3:	14.33	2.31	0.00	0.42
3-4:	14.49	2.35	0.00	0.42
4-5:	14.71	2.44	0.00	0.42
5-6:	15.45	2.58	0.00	0.58
6-7:	16.94	2.62	0.00	0.58

GC 107078

RUN 2

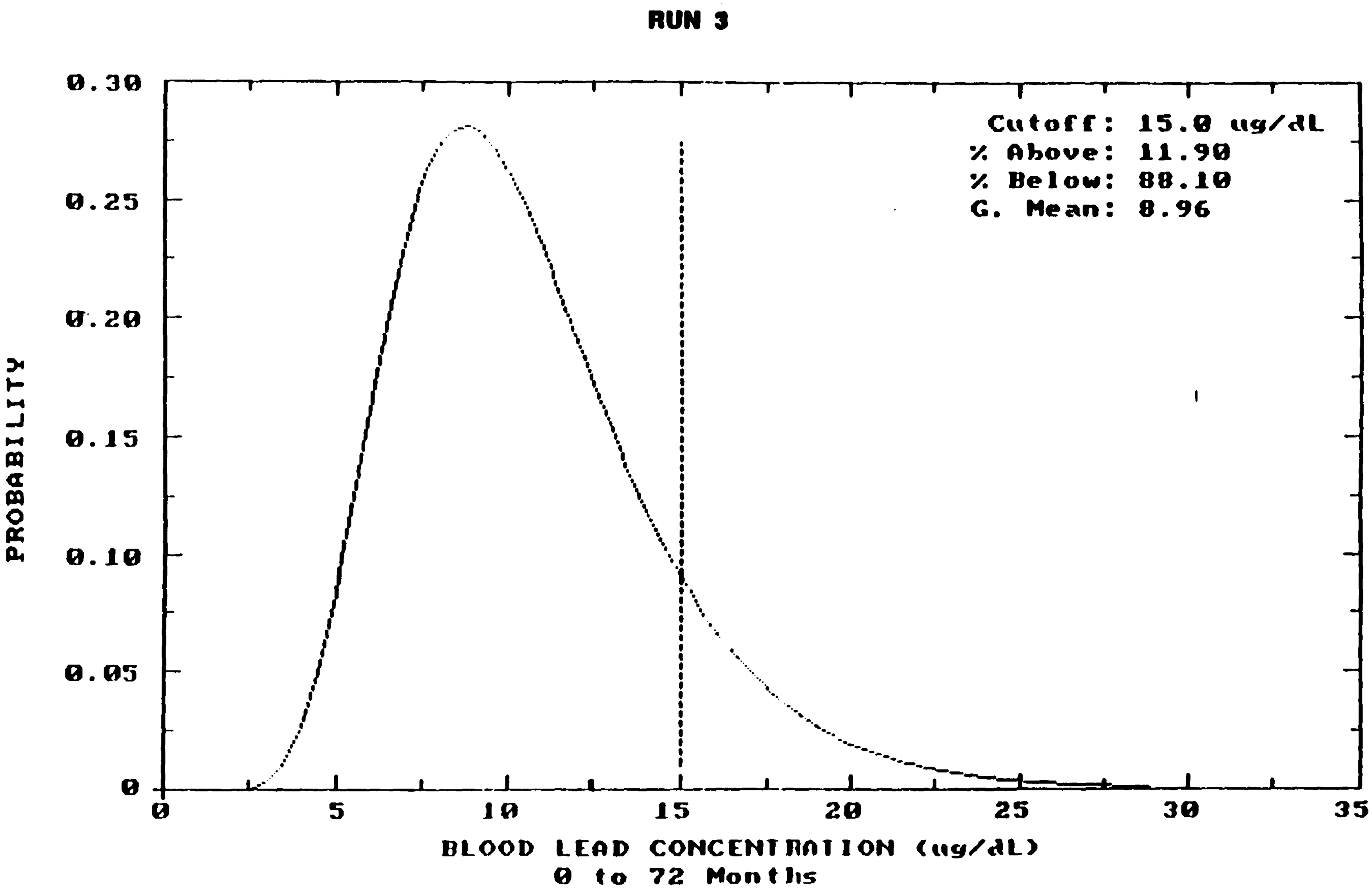


RUN 3

YEAR	Blood Level (ug/dL)	Total Uptake (ug/day)	Soil+Dust Uptake (ug/day)
0.5-1:	3.88	11.38	7.50
1-2:	7.98	35.55	29.74
2-3:	9.92	36.09	29.53
3-4:	10.33	36.01	29.28
4-5:	10.72	35.82	28.96
5-6:	10.69	35.83	28.58
6-7:	10.51	35.67	28.14

YEAR	Diet Uptake (ug/day)	Water Uptake (ug/day)	Paint Uptake (ug/day)	Air Uptake (ug/day)
0.5-1:	2.92	0.90	0.00	0.05
1-2:	3.47	2.25	0.00	0.09
2-3:	4.06	2.34	0.00	0.16
3-4:	4.17	2.38	0.00	0.17
4-5:	4.21	2.47	0.00	0.17
5-6:	4.41	2.61	0.00	0.24
6-7:	4.64	2.65	0.00	0.24

GC 107080

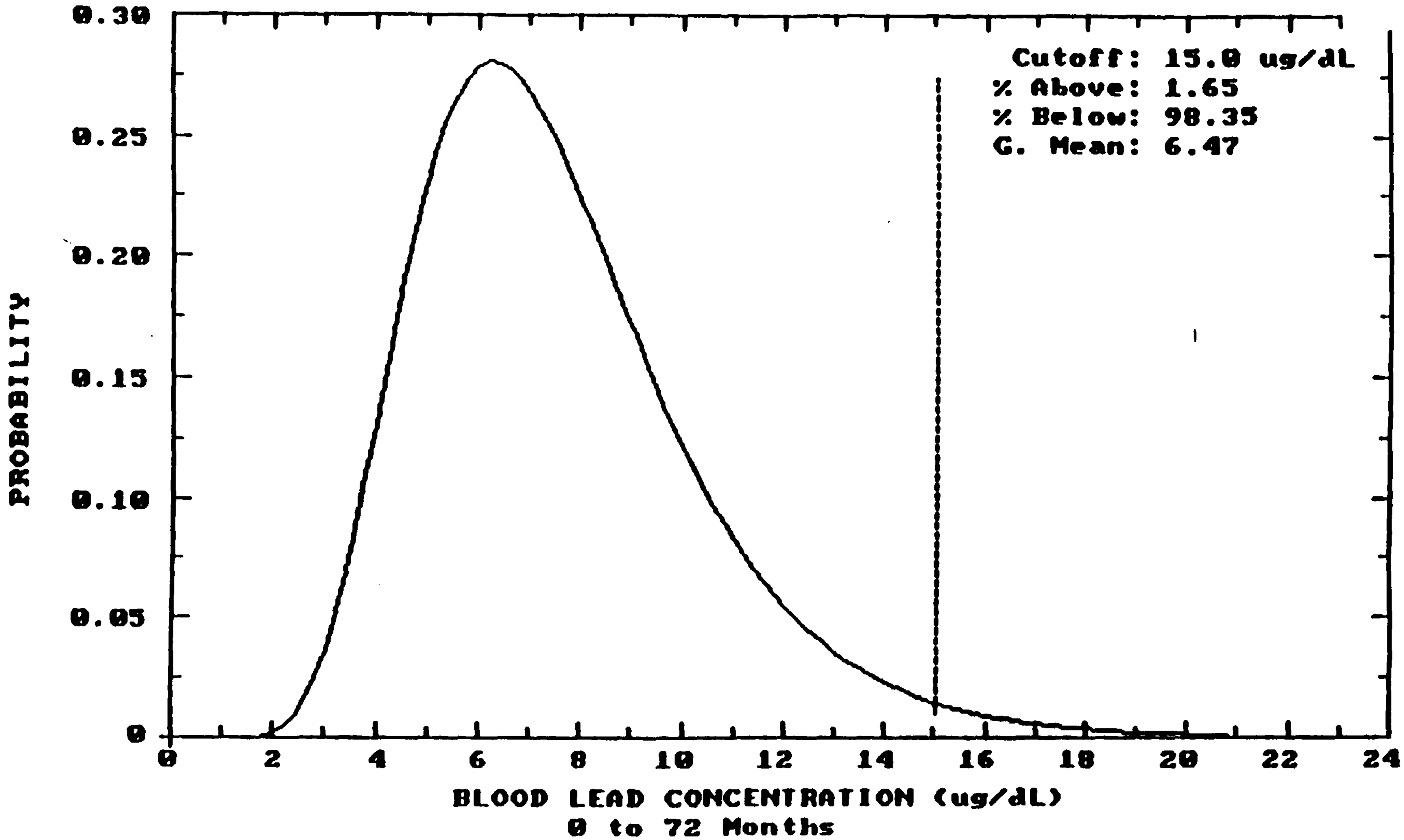

RUN 3
Cutoff: 15.0 ug/dL
% Above: 11.90
% Below: 88.10
G. Mean: 8.96
PROBABILITY
0.30
0.25
0.20
0.15
0.10
0.05
0
0
5
10
15
20
25
30
35
BLOOD LEAD CONCENTRATION (ug/dL)
0 to 72 Months

RUN 4

YEAR	Blood Level (ug/dL)	Total Uptake (ug/day)	Soil+Dust Uptake (ug/day)
0.5-1:	3.08	8.62	4.75
1-2:	5.66	24.71	18.93
2-3:	6.96	25.40	18.87
3-4:	7.29	25.51	18.81
4-5:	7.61	25.55	18.72
5-6:	7.64	25.84	18.62
6-7:	7.59	26.00	18.50

YEAR	Diet Uptake (ug/day)	Water Uptake (ug/day)	Paint Uptake (ug/day)	Air Uptake (ug/day)
0.5-1:	2.92	0.89	0.00	0.05
1-2:	3.47	2.22	0.00	0.09
2-3:	4.06	2.31	0.00	0.16
3-4:	4.17	2.35	0.00	0.17
4-5:	4.21	2.44	0.00	0.17
5-6:	4.41	2.58	0.00	0.24
6-7:	4.64	2.62	0.00	0.24

RUN 4

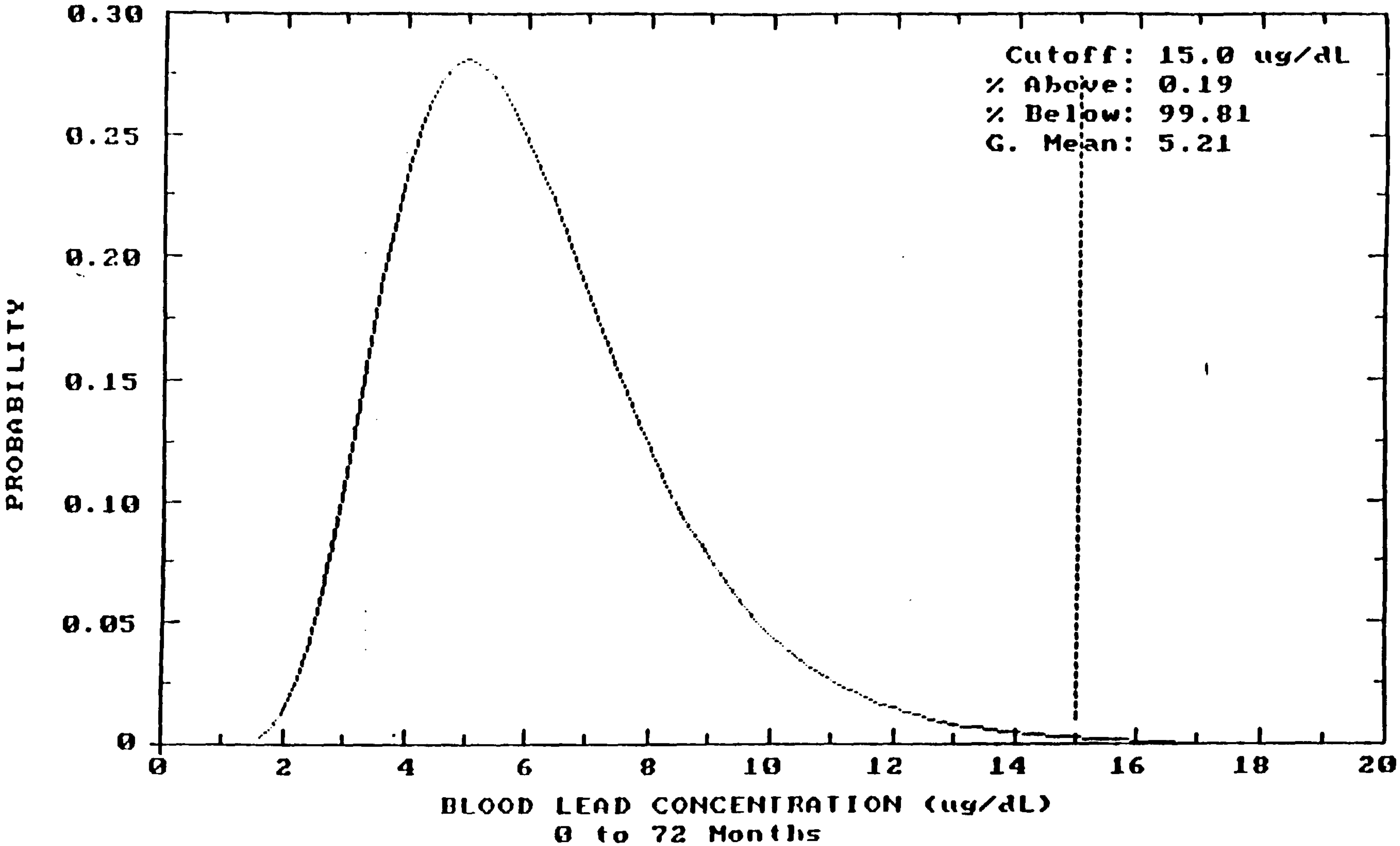

Cutoff: 15.0 ug/dL
% Above: 1.65
% Below: 98.35
G. Mean: 6.47
PROBABILITY
0.30
0.25
0.20
0.15
0.10
0.05
0
0
2
4
6
8
10
12
14
16
18
20
22
24
BLOOD LEAD CONCENTRATION (ug/dL)
0 to 72 Months

RUN 5

YEAR	Blood Level (ug/dL)	Total Uptake (ug/day)	Soil+Dust Uptake (ug/day)
0.5-1:	2.69	7.24	3.37
1-2:	4.50	19.27	13.49
2-3:	5.48	20.00	13.48
3-4:	5.75	20.16	13.46
4-5:	6.02	20.27	13.44
5-6:	6.08	20.64	13.42
6-7:	6.07	20.89	13.39

YEAR	Diet Uptake (ug/day)	Water Uptake (ug/day)	Paint Uptake (ug/day)	Air Uptake (ug/day)
0.5-1:	2.92	0.89	0.00	0.05
1-2:	3.47	2.22	0.00	0.09
2-3:	4.06	2.31	0.00	0.16
3-4:	4.17	2.35	0.00	0.17
4-5:	4.21	2.44	0.00	0.17
5-6:	4.41	2.58	0.00	0.24
6-7:	4.64	2.62	0.00	0.24

RUN 5


Cutoff: 15.0 ug/dL
% Above: 0.19
% Below: 99.81
G. Mean: 5.21
PROBABILITY
0.30
0.25
0.20
0.15
0.10
0.05
0
0
2
4
6
8
10
12
14
16
18
20
BLOOD LEAD CONCENTRATION (ug/dL)
0 to 72 Months

RUN 6

YEAR	Blood Level (ug/dL)	Total Uptake (ug/day)	Soil+Dust Uptake (ug/day)
0.5-1:	2.94	8.12	4.26
1-2:	5.25	22.75	16.97
2-3:	6.43	23.45	16.93
3-4:	6.73	23.57	16.87
4-5:	7.03	23.63	16.80
5-6:	7.07	23.94	16.72
6-7:	7.03	24.12	16.61

YEAR	Diet Uptake (ug/day)	Water Uptake (ug/day)	Paint Uptake (ug/day)	Air Uptake (ug/day)
0.5-1:	2.92	0.89	0.00	0.05
1-2:	3.47	2.22	0.00	0.09
2-3:	4.06	2.31	0.00	0.16
3-4:	4.17	2.35	0.00	0.17
4-5:	4.21	2.44	0.00	0.17
5-6:	4.41	2.58	0.00	0.24
6-7:	4.64	2.62	0.00	0.24

GC 107085

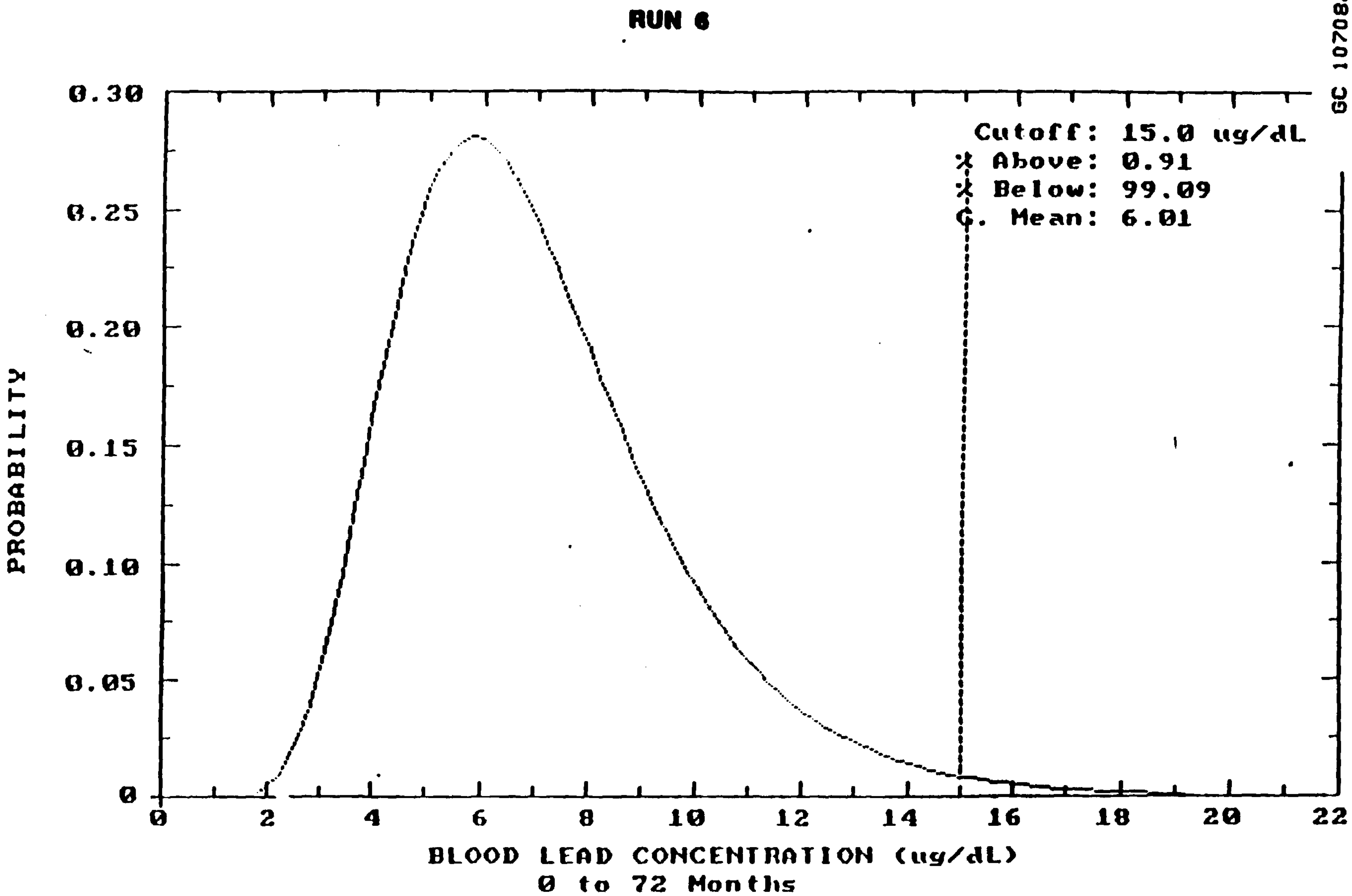

RUN 6
Cutoff: 15.0 ug/dL
% Above: 0.91
% Below: 99.09
G. Mean: 6.01
PROBABILITY
0.30
0.25
0.20
0.15
0.10
0.05
0
0 2 4 6 8 10 12 14 16 18 20 22
BLOOD LEAD CONCENTRATION (ug/dL)
0 to 72 Months
GC 107086

TABLE 6

UPTAKE/BIOKINETIC MODEL PREDICTIONS OF LEAD ABSORPTION FROM SOIL AT DIFFERENT SOIL PB LEVELS, BASED UPON THE MIDVALE DATA SET

Soil Pb (ppm)		% Soil Pb Absorption	N
0- 250		44	40
251- 500		25	20
501- 750		29	22
750-1000		16	13
< 1000		21	14
		—	—
	TOTAL SITE	32	109

APPENDIX 1

ADJUSTMENT OF THE UPTAKE/BIOKINETIC MODEL SOIL PB ABSORPTION PARAMETER BY CALIBRATION OF THE MODEL AGAINST THE MIDVALE, UTAH DATA SET

Table A-1 is a display of all the records in the Midvale Data Set for children as reported by Bornschein, et al. (1990). For each record, the percent Pb absorption from soil/house dust has been calculated on a Lotus spreadsheet. Definitions for column headings and equations used in this analysis are as follows:

1. Observation: As recorded by Bornschein, et al.
2. Age: Years of age of subject.
3. Soil Pb: Mean soil Pb level around the exterior of the subject's home, including yard, house perimeter, garden and exterior dust Pb levels.
4. Dust Pb: House dust Pb level.
5. Blood Pb Air: The contribution to blood Pb that can be assigned to airborne Pb as calculated by:

   Blood Pb Air = (Pb Air) (Respiration Rate) (% Pb Absorption from Air) (C_{Blood})

   where:

   Pb Air = Ambient Pb level. For Midvale it is assumed to be 0.20 $\mu g/m^3$

   Respiration Rate = 4.6 liters/day for 0 to 6-year-old children

   % Pb Absorption from Air = 50%

   C_{Blood} = Factor to convert absorbed Pb (μg) to blood Pb (μg/dl) = 0.287

6. Blood Pb Diet: The contribution to blood Pb that can be attributed to dietary Pb. Estimates for 1990-1996 dietary Pb were used to calculate Blood Pb Diet by:

   (Mean Dietary Pb) (Pb Absorption from Diet) (C_{Blood})

where:

Mean Dietary Pb Ingestion (0 to 6-year-old) = 10.21 µg/day

Pb Absorption from Diet = 39%

C_{Blood} as described above.

7. Blood Pb Water: The contribution to blood Pb that can be attributed to Pb in water as calculated by:

(Pb Water) (Pb Absorption from Water) (Water Ingestion/Day) (C_{Blood})

where:

Pb Water = 8.88 µg/liter for the national average Pb level in water

Pb Absorption from Water = 50%

Water Ingestion/Day = 0.48 liters/day for 0 to 6-year-old children

C_{Blood} as described above

8. Total Non-Dirt Blood Pb: The contribution to blood Pb then can be attributed to diet, water and air as calculated by:

(Blood Pb Air) + (Blood Pb Diet) + (Blood Pb Water)

9. Actual Blood Pb: Data for each record taken from Bornschein, et al. data set.

10. Blood Pb Soil and Dust: The contribution to blood Pb that could be attributed to soil/dust as calculated by:

(Actual Blood Pb) - (Total Non-Dirt Blood Pb)

11. Blood Pb Soil + Dust Ingestion (100 mg): The blood Pb contribution that could be attributed4d to soil/dust assuming 100 mg soil ingestion and 100% absorption of Pb from soil/dust as calculated by:

(T.W.A. Soil/Dust Pb) (0.1 Gram Soil Ingestion) (C_{Blood})

where:

T.W.A. Soil/Dust Pb = The time-weighted average for soil/dust Pb in ppm, based upon 2.67 hours of outdoor Pb exposure and 9.33 indoor Pb exposure

12. % Absorption Soil/Dust (100 mg ingestion): The percentage Pb absorption from soil and house dust, assuming 100 mg soil ingestion/day, as calculated by:

Blood Pb Soil + Dust + Blood Pb Soil + Dust Ingestion

where:

Blood Pb Soil + Dust = Parameter #10 described above

Blood Pb Soil + Dust Ingestion = Parameter #11 described above

Table A-2 nests the records by soil Pb level, placing them into either the 0-250, 251-500, 501-750, 751-1000 or > 1000 ppm group. The average absorption of soil Pb for each group was then calculated. Records in which soil Pb or dust Pb levels were missing are excluded. For records with negative soil Pb absorption values, a value of 0 was used.

TABLE A-1
MIDVALE HOUSE DUST, SOIL AND BLOOD LEAD DATA
CALCULATED PERCENT LEAD ABSORBTION FROM SOIL AND DUST
ORIGINAL DATA SET

OBSERVATION (#)	AGE (years)	SOIL Pb (ppm)	DUST Pb (ppm)	BLOOD Pb AIR	BLOOD Pb DIET	BLOOD Pb WATER	TOTAL NON-DIRT BLOOD Pb	ACTUAL BLOOD Pb	BLOOD Pb SOIL + DUST	BLOOD Pb SOIL + DUST INGESTION(100mg)	% ABSORPTION SOIL/DUST (100mg ingest)
1.00	1.20	974.00	718.00	0.18	1.14	0.61	1.93	9.00	7.07	22.44	0.31
2.00	1.75	911.00	998.00	0.18	1.14	0.61	1.93	3.00	1.07	19.41	0.00
3.00	2.10	986.00	1110.00	0.18	1.14	0.61	1.93	5.50	3.57	30.61	0.12
4.00	1.83	620.67	249.00	0.18	1.14	0.61	1.93	2.50	0.57	9.81	0.00
5.00	3.00	409.00	541.00	0.18	1.14	0.61	1.93	5.50	3.57	15.15	0.24
6.00	1.83	362.20	363.00	0.18	1.14	0.61	1.93	8.00	6.07	11.85	0.51
7.00	1.83	440.00	341.00	0.18	1.14	0.61	1.93	9.00	7.07	10.50	0.67
8.00	5.42	528.25	466.00	0.18	1.14	0.61	1.93	6.50	4.57	13.82	0.33
9.00	5.25	535.00	1263.00	0.18	1.14	0.61	1.93	4.50	2.57	31.02	0.08
10.00	1.50	646.50	474.00	0.18	1.14	0.61	1.93	3.00	1.07	14.84	0.00
11.00	1.42	1391.00	1196.00	0.18	1.14	0.61	1.93	6.00	4.07	35.72	0.11
12.00	2.00	464.25	640.00	0.18	1.14	0.61	1.93	8.50	6.57	17.11	0.38
13.00	1.17	371.00	390.00	0.18	1.14	0.61	1.93	5.50	3.57	11.06	0.32
14.00	4.58	747.00	692.00	0.18	1.14	0.61	1.93	9.00	7.07	20.26	0.35
15.00	1.00	872.00	1067.00	0.18	1.14	0.61	1.93	6.00	4.07	29.22	0.14
16.00	1.83	999.00	617.00	0.18	1.14	0.61	1.93	6.00	4.07	20.45	0.20
17.00	3.33	1600.50	1343.00	0.18	1.14	0.61	1.93	15.50	13.57	40.97	0.33
18.00	3.50	990.00	3602.00	0.18	1.14	0.61	1.93	2.00	0.07	84.64	0.00
19.00	3.58	1148.00	567.00	0.18	1.14	0.61	1.93	16.50	14.57	20.44	0.71
20.00	5.67	295.00	340.00	0.18	1.14	0.61	1.93	4.00	2.07	9.44	0.22
21.00	1.25	735.00	509.00	0.18	1.14	0.61	1.93	6.00	4.07	16.23	0.25
22.00	1.50	760.00	475.00	0.18	1.14	0.61	1.93	7.00	5.07	15.73	0.32
23.00	5.92	1761.75	651.00	0.18	1.14	0.61	1.93	5.50	3.57	26.65	0.13
24.00	4.33	817.00	1037.00	0.18	1.14	0.61	1.93	7.50	5.57	28.18	0.20
25.00	1.17	-	517.00	0.18	1.14	0.61	1.93	5.50	3.57	11.13	0.32
26.00	1.92	-	265.00	0.18	1.14	0.61	1.93	8.00	6.07	5.70	1.06
27.00	1.33	1596.50	736.00	0.18	1.14	0.61	1.93	3.00	1.07	27.30	0.00
28.00	4.00	351.00	540.00	0.18	1.14	0.61	1.93	7.00	5.07	14.14	0.36
29.00	4.67	350.50	588.00	0.18	1.14	0.61	1.93	1.50	-0.43	15.17	0.00
30.00	0.83	351.00	1138.00	0.18	1.14	0.61	1.93	7.00	5.07	27.01	0.19
31.00	4.17	2361.50	756.00	0.18	1.14	0.61	1.93	8.00	6.07	33.14	0.18
32.00	1.92	1220.00	750.00	0.18	1.14	0.61	1.93	10.50	8.57	25.14	0.34
33.00	3.33	-	557.00	0.18	1.14	0.61	1.93	5.00	3.07	11.99	0.26
34.00	2.58	-	438.00	0.18	1.14	0.61	1.93	6.00	4.07	9.43	0.43
35.00	4.50	-	422.00	0.18	1.14	0.61	1.93	18.00	16.07	9.08	1.77
36.00	3.67	-	641.00	0.18	1.14	0.61	1.93	4.00	2.07	13.80	0.15
37.00	2.17	-	459.00	0.18	1.14	0.61	1.93	4.00	2.07	9.80	0.21
38.00	2.33	-	511.00	0.18	1.14	0.61	1.93	6.00	4.07	11.00	0.37
39.00	4.08	1301.00	1605.00	0.18	1.14	0.61	1.93	13.00	11.07	43.08	0.25
40.00	1.08	1689.00	1313.00	0.18	1.14	0.61	1.93	5.50	3.57	40.17	0.09
41.00	4.58	756.00	658.00	0.18	1.14	0.61	1.93	7.50	5.57	19.59	0.28
42.00	0.83	207.75	-	0.18	1.14	0.61	1.93	6.00	4.07	2.06	1.97
43.00	3.33	723.00	513.00	0.18	1.14	0.61	1.93	3.00	1.07	16.23	0.00
44.00	1.17	723.00	292.00	0.18	1.14	0.61	1.93	10.00	8.07	11.47	0.70
45.00	1.92	1015.50	926.00	0.18	1.14	0.61	1.93	3.50	1.57	27.22	0.06
46.00	5.58	876.00	605.00	0.18	1.14	0.61	1.93	4.00	2.07	19.31	0.11
47.00	1.08	876.00	603.00	0.18	1.14	0.61	1.93	3.50	1.57	19.26	0.08
48.00	1.67	876.00	678.00	0.18	1.14	0.61	1.93	6.00	4.07	20.88	0.19
49.00	2.92	445.25	-	0.18	1.14	0.61	1.93	6.00	4.07	3.19	1.27

TABLE A-1 (continued)
MIDVALE HOUSE DUST, SOIL AND BLOOD LEAD DATA
CALCULATED PERCENT LEAD ABSORBTION FROM SOIL AND DUST
ORIGINAL DATA SET

50.00	5.17	595.00	-	0.18	1.14	0.61	1.93	4.50	2.57	4.27	0.60
51.00	0.58	721.75	1375.00	0.18	1.14	0.61	1.93	3.50	1.57	34.78	0.05
52.00	3.92	-	523.00	0.18	1.14	0.61	1.93	5.50	3.57	11.26	0.32
53.00	3.33	-	208.00	0.18	1.14	0.61	1.93	6.50	4.57	4.48	1.02
54.00	1.00	-	724.00	0.18	1.14	0.61	1.93	5.50	3.57	15.58	0.23
55.00	3.17	-	1301.00	0.18	1.14	0.61	1.93	13.00	11.07	28.00	0.40
56.00	2.50	357.25	1177.00	0.18	1.14	0.61	1.93	4.50	2.57	27.90	0.03
57.00	1.58	357.25	873.00	0.18	1.14	0.61	1.93	16.50	14.57	21.35	0.68
58.00	0.67	711.75	253.00	0.18	1.14	0.61	1.93	8.50	6.57	10.55	0.62
59.00	4.42	393.00	-	0.18	1.14	0.61	1.93	2.00	0.07	2.82	0.00
60.00	3.17	393.00	707.00	0.18	1.14	0.61	1.93	4.00	2.07	19.76	0.10
61.00	0.67	1009.40	831.00	0.18	1.14	0.61	1.93	13.50	11.57	25.13	0.46
62.00	2.67	1009.40	-	0.18	1.14	0.61	1.93	13.00	11.07	7.24	1.53
63.00	4.83	1009.40	2274.00	0.18	1.14	0.61	1.93	5.00	3.07	56.19	0.05
64.00	3.92	1727.00	1130.00	0.18	1.14	0.61	1.93	5.00	3.07	36.89	0.08
65.00	2.75	637.00	412.00	0.18	1.14	0.61	1.93	14.50	12.57	13.44	0.94
66.00	2.08	550.00	568.00	0.18	1.14	0.61	1.93	6.50	4.57	16.17	0.2[illegible]
67.00	0.67	342.00	237.00	0.18	1.14	0.61	1.93	4.50	2.57	7.56	0.34
68.00	1.42	527.67	559.00	0.18	1.14	0.61	1.93	4.50	2.57	15.82	0.16
69.00	1.50	527.67	296.00	0.18	1.14	0.61	1.93	7.00	5.07	10.16	0.50
70.00	0.67	527.67	293.00	0.18	1.14	0.61	1.93	5.50	3.57	10.09	0.35
71.00	3.50	527.67	347.00	0.18	1.14	0.61	1.93	4.00	2.07	11.26	0.18
72.00	3.50	527.67	425.00	0.18	1.14	0.61	1.93	9.00	7.07	12.93	0.55
73.00	2.33	380.00	236.00	0.18	1.14	0.61	1.93	4.00	2.07	7.81	0.26
74.00	5.33	380.50	346.00	0.18	1.14	0.61	1.93	6.00	4.07	10.18	0.40
75.00	2.00	632.00	532.00	0.18	1.14	0.61	1.93	7.00	5.07	15.99	0.32
76.00	2.58	512.75	514.00	0.18	1.14	0.61	1.93	4.00	2.07	14.74	0.14
77.00	5.50	187.00	253.00	0.18	1.14	0.61	1.93	3.50	1.57	6.79	0.23
78.00	5.58	187.00	230.00	0.18	1.14	0.61	1.93	2.00	0.07	6.29	0.00
79.00	4.17	187.00	218.00	0.18	1.14	0.61	1.93	6.50	4.57	6.03	0.76
80.00	4.08	187.00	212.00	0.18	1.14	0.61	1.93	7.50	5.57	5.91	0.94
81.00	2.25	187.00	124.00	0.18	1.14	0.61	1.93	8.00	6.07	4.01	1.51
82.00	4.08	190.00	201.00	0.18	1.14	0.61	1.93	5.00	3.07	5.69	0.54
83.00	1.17	366.00	336.00	0.18	1.14	0.61	1.93	3.50	1.57	9.06	0.16
84.00	2.08	366.00	410.00	0.18	1.14	0.61	1.93	3.00	1.07	11.45	0.00
85.00	0.92	366.00	412.00	0.18	1.14	0.61	1.93	5.50	3.57	11.49	0.31
86.00	3.17	507.33	756.00	0.18	1.14	0.61	1.93	2.00	0.07	19.91	0.00
87.00	4.58	1078.00	485.00	0.18	1.14	0.61	1.93	5.00	3.07	18.17	0.17
88.00	3.67	150.67	395.00	0.18	1.14	0.61	1.93	2.00	0.07	9.64	0.00
89.00	1.92	514.67	280.00	0.18	1.14	0.61	1.93	3.00	1.07	9.72	0.00
90.00	2.58	243.00	259.00	0.18	1.14	0.61	1.93	5.00	3.07	7.32	0.42
91.00	2.25	181.40	511.00	0.18	1.14	0.61	1.93	6.00	4.07	12.30	0.33
92.00	4.92	212.00	294.00	0.18	1.14	0.61	1.93	2.00	0.07	7.85	0.00
93.00	0.92	420.00	342.00	0.18	1.14	0.61	1.93	3.50	1.57	10.38	0.15
94.00	2.25	286.50	308.00	0.18	1.14	0.61	1.93	2.50	0.57	9.83	0.00
95.00	0.50	239.33	265.00	0.18	1.14	0.61	1.93	5.00	3.07	7.42	0.41
96.00	2.83	180.00	254.00	0.18	1.14	0.61	1.93	5.50	3.57	6.76	0.53
97.00	0.75	230.50	407.00	0.18	1.14	0.61	1.93	6.00	4.07	10.47	0.39
98.00	5.17	207.00	226.00	0.18	1.14	0.61	1.93	4.00	2.07	6.35	0.33
99.00	3.50	370.00	439.00	0.18	1.14	0.61	1.93	3.00	1.07	12.10	0.00
100.00	2.58	174.00	-	0.18	1.14	0.61	1.93	5.00	3.07	1.25	2.46
101.00	4.25	111.60	186.00	0.18	1.14	0.61	1.93	4.00	2.07	4.80	0.43
102.00	0.58	247.00	343.00	0.18	1.14	0.61	1.93	0.50	-1.43	9.16	0.00
103.00	2.50	126.00	239.00	0.18	1.14	0.61	1.93	5.50	3.57	6.05	0.59
104.00	0.58	144.00	-	0.18	1.14	0.61	1.93	3.00	1.07	1.03	0.00
105.00	4.42	127.75	414.00	0.18	1.14	0.61	1.93	4.00	2.07	9.83	0.21
106.00	4.50	144.40	183.00	0.18	1.14	0.61	1.93	4.50	2.57	4.98	0.52
107.00	2.58	159.00	214.00	0.18	1.14	0.61	1.93	2.50	0.57	5.75	0.00
108.00	2.42	165.80	244.00	0.18	1.14	0.61	1.93	2.50	0.57	6.44	0.00

TABLE A-1 (continued)
MIDVALE HOUSE DUST, SOIL AND BLOOD LEAD DATA
CALCULATED PERCENT LEAD ABSORPTION FROM SOIL AND DUST
ORIGINAL DATA SET

109.00	5.92	895.00	459.00	0.18	1.14	0.61	1.93	4.00	2.07	16.30	0.13
110.00	1.75	117.67	340.00	0.18	1.14	0.61	1.93	5.50	3.57	8.16	0.44
111.00	4.00	242.00	271.00	0.18	1.14	0.61	1.93	8.50	6.57	7.57	0.87
112.00	2.75	270.50	449.00	0.18	1.14	0.61	1.93	3.50	1.57	11.61	0.13
113.00	0.58	232.00	210.00	0.18	1.14	0.61	1.93	1.00	-0.93	6.18	0.00
114.00	5.25	115.25	207.00	0.18	1.14	0.61	1.93	2.50	0.57	7.00	0.00
115.00	4.00	103.00	336.00	0.18	1.14	0.61	1.93	5.50	3.57	7.97	0.45
116.00	2.42	109.67	146.00	0.18	1.14	0.61	1.93	3.00	1.07	3.93	0.00
117.00	4.25	171.00	192.00	0.18	1.14	0.61	1.93	5.00	3.07	5.36	0.57
118.00	4.92	123.00	314.00	0.18	1.14	0.61	1.93	6.00	4.07	7.64	0.53
119.00	2.00	226.00	207.00	0.18	1.14	0.61	1.93	4.50	2.57	6.08	0.42
120.00	2.08	123.00	227.00	0.18	1.14	0.61	1.93	12.00	10.07	5.77	1.74
121.00	4.58	93.00	226.00	0.18	1.14	0.61	1.93	5.00	3.07	5.53	0.55
122.00	2.33	116.00	394.00	0.18	1.14	0.61	1.93	3.50	1.57	9.31	0.17
123.00	0.67	116.00	277.00	0.18	1.14	0.61	1.93	1.50	-0.43	6.79	0.00
124.00	4.00	118.67	119.00	0.18	1.14	0.61	1.93	5.00	3.07	3.41	0.90
125.00	0.58	177.00	149.00	0.18	1.14	0.61	1.93	3.00	1.07	4.48	0.00
126.00	3.25	151.00	285.00	0.18	1.14	0.61	1.93	7.50	5.57	7.22	0.77
127.00	2.50	69.00	245.00	0.18	1.14	0.61	1.93	5.50	3.57	5.77	0.62
128.00	5.58	74.00	206.00	0.18	1.14	0.61	1.93	8.50	6.57	4.97	1.32

TABLE A-2
MIDVALE HOUSE DUST, SOIL AND BLOOD LEAD DATA
CALCULATED PERCENT LEAD ABSORBTION FROM SOIL AND DUST
SORTED BY GROUPINGS OF SOIL LEAD CONCENTRATION

OBSERVATION (#)	AGE (years)	SOIL Pb (ppm)	DUST Pb (ppm)	BLOOD Pb AIR	BLOOD Pb DIET	BLOOD Pb WATER	TOTAL NON-DIRT BLOOD Pb	ACTUAL BLOOD Pb	NET BLOOD Pb SOIL + DUST	BLOOD Pb SOIL + DUST INGESTION(100mg)	% ABSORPTION SOIL/DUST (100mg ingest)	% AVERAGE Pb ABSORBTION (100mg ingest)
53.00	3.33	-	208.00	0.18	1.14	0.61	1.93	6.50	4.57	4.48	1.02	
35.00	4.50	-	422.00	0.18	1.14	0.61	1.93	18.00	16.07	9.08	1.77	
55.00	3.17	-	1301.00	0.18	1.14	0.61	1.93	13.00	11.07	28.00	0.40	
36.00	3.67	-	641.00	0.18	1.14	0.61	1.93	4.00	2.07	13.00	0.15	
52.00	3.92	-	523.00	0.18	1.14	0.61	1.93	5.50	3.57	11.26	0.32	
37.00	2.17	-	459.00	0.18	1.14	0.61	1.93	4.00	2.07	9.88	0.21	
54.00	1.00	-	724.00	0.18	1.14	0.61	1.93	5.50	3.57	15.58	0.23	
25.00	1.17	-	517.00	0.18	1.14	0.61	1.93	5.50	3.57	11.13	0.32	
34.00	2.58	-	438.00	0.18	1.14	0.61	1.93	6.00	4.07	9.43	0.43	
33.00	3.33	-	557.00	0.18	1.14	0.61	1.93	5.00	3.07	11.99	0.26	
26.00	1.92	-	265.00	0.18	1.14	0.61	1.93	8.00	6.07	5.70	1.06	
38.00	2.33	-	511.00	0.18	1.14	0.61	1.93	6.00	4.07	11.00	0.37	
127.00	2.50	69.00	245.00	0.18	1.14	0.61	1.93	5.50	3.57	5.77	0.62	
128.00	5.58	74.00	206.00	0.18	1.14	0.61	1.93	8.50	6.57	4.97	1.32	
121.00	4.58	93.00	226.00	0.18	1.14	0.61	1.93	5.00	3.07	5.53	0.55	
115.00	4.00	103.00	336.00	0.18	1.14	0.61	1.93	5.50	3.57	7.97	0.45	
116.00	2.42	109.67	146.00	0.18	1.14	0.61	1.93	3.00	1.07	3.93	0.00	
101.00	4.25	111.60	186.00	0.18	1.14	0.61	1.93	4.00	2.07	4.80	0.43	
114.00	5.25	115.25	287.00	0.18	1.14	0.61	1.93	2.50	0.57	7.00	0.00	
123.00	0.67	116.00	277.00	0.18	1.14	0.61	1.93	1.50	-0.43	6.79	0.00	
122.00	2.33	116.00	394.00	0.18	1.14	0.61	1.93	3.50	1.57	9.31	0.17	
110.00	1.75	117.67	340.00	0.18	1.14	0.61	1.93	5.50	3.57	8.16	0.44	
124.00	4.00	118.67	119.00	0.18	1.14	0.61	1.93	5.00	3.07	3.41	0.90	
118.00	4.92	123.00	314.00	0.18	1.14	0.61	1.93	6.00	4.07	7.64	0.53	
120.00	2.08	123.00	227.00	0.18	1.14	0.61	1.93	12.00	10.07	5.77	1.74	
103.00	2.50	126.00	239.00	0.18	1.14	0.61	1.93	5.50	3.57	6.05	0.59	
105.00	4.42	127.75	414.00	0.18	1.14	0.61	1.93	4.00	2.07	9.83	0.21	
106.00	4.50	144.40	183.00	0.18	1.14	0.61	1.93	4.50	2.57	4.90	0.52	
126.00	3.25	151.00	285.00	0.18	1.14	0.61	1.93	7.50	5.57	7.22	0.77	
88.00	3.67	158.67	395.00	0.18	1.14	0.61	1.93	2.00	0.07	9.64	0.00	
107.00	2.58	159.00	214.00	0.18	1.14	0.61	1.93	2.50	0.57	5.75	0.00	
108.00	2.42	165.80	244.00	0.18	1.14	0.61	1.93	2.50	0.57	6.44	0.00	
117.00	4.25	171.00	192.00	0.18	1.14	0.61	1.93	5.00	3.07	5.36	0.57	
125.00	0.58	177.00	149.00	0.18	1.14	0.61	1.93	3.00	1.07	4.48	0.00	
96.00	2.83	180.00	254.00	0.18	1.14	0.61	1.93	5.50	3.57	6.76	0.53	
91.00	2.25	181.40	511.00	0.18	1.14	0.61	1.93	6.00	4.07	12.30	0.33	
81.00	2.25	187.00	124.00	0.18	1.14	0.61	1.93	8.00	6.07	4.01	1.51	
78.00	5.58	187.00	230.00	0.18	1.14	0.61	1.93	2.00	0.07	6.29	0.00	
80.00	4.08	187.00	212.00	0.18	1.14	0.61	1.93	7.50	5.57	5.91	0.94	
77.00	5.50	187.00	253.00	0.18	1.14	0.61	1.93	3.50	1.57	6.79	0.23	
79.00	4.17	187.00	218.00	0.18	1.14	0.61	1.93	6.50	4.57	6.03	0.76	
82.00	4.08	190.00	201.00	0.18	1.14	0.61	1.93	5.00	3.07	5.69	0.54	
94.00	2.25	206.50	388.00	0.18	1.14	0.61	1.93	2.50	0.57	9.83	0.00	
98.00	5.17	207.00	226.00	0.18	1.14	0.61	1.93	4.00	2.07	6.35	0.33	
92.00	4.92	212.00	294.00	0.18	1.14	0.61	1.93	2.00	0.07	7.85	0.00	
119.00	2.80	226.00	207.00	0.18	1.14	0.61	1.93	4.50	2.57	6.08	0.42	
113.00	0.58	232.00	210.00	0.18	1.14	0.61	1.93	1.00	-0.93	6.18	0.00	
97.00	0.75	238.50	407.00	0.18	1.14	0.61	1.93	6.00	4.07	10.47	0.39	
95.00	0.50	239.33	265.00	0.18	1.14	0.61	1.93	5.00	3.07	7.42	0.41	
111.00	4.00	242.00	271.00	0.18	1.14	0.61	1.93	8.50	6.57	7.57	0.87	
90.00	2.50	243.00	259.00	0.18	1.14	0.61	1.93	5.00	3.07	7.32	0.42	
102.00	0.58	247.00	343.00	0.18	1.14	0.61	1.93	0.50	-1.43	[illegible]	0.00	0.44

TABLE A-2 (continued)
MIDVALE HOUSE DUST, SOIL AND BLOOD LEAD DATA
CALCULATED PERCENT LEAD ABSORBTION FROM SOIL AND DUST
SORTED BY GROUPINGS OF SOIL LEAD CONCENTRATION

112.00	2.75	270.50	449.00	0.18	1.14	0.61	1.93	3.50	1.57	11.61	0.13	
20.00	5.67	295.00	340.00	0.18	1.14	0.61	1.93	4.00	2.07	9.44	0.22	
67.00	0.67	342.00	237.00	0.18	1.14	0.61	1.93	4.50	2.57	7.56	0.34	
29.00	4.67	350.50	588.00	0.18	1.14	0.61	1.93	1.50	-0.43	15.17	0.00	
28.00	4.00	351.00	540.00	0.18	1.14	0.61	1.93	7.00	5.07	14.14	0.36	
30.00	0.83	351.00	1138.00	0.18	1.14	0.61	1.93	7.00	5.07	27.01	0.19	
57.00	1.58	357.25	873.00	0.18	1.14	0.61	1.93	16.50	14.57	21.35	0.68	
56.00	2.58	357.25	1177.00	0.18	1.14	0.61	1.93	4.50	2.57	27.90	0.09	
80.00	1.17	366.00	336.00	0.18	1.14	0.61	1.93	3.50	1.57	9.86	0.16	
85.00	0.92	366.00	412.00	0.18	1.14	0.61	1.93	5.50	3.57	11.49	0.31	
84.00	2.08	366.00	410.00	0.18	1.14	0.61	1.93	3.00	1.07	11.45	0.00	
99.00	3.58	370.00	439.00	0.18	1.14	0.61	1.93	3.00	1.07	12.10	0.00	
13.00	1.17	371.00	390.00	0.18	1.14	0.61	1.93	5.50	3.57	11.06	0.32	
73.00	2.33	380.00	236.00	0.18	1.14	0.61	1.93	4.00	2.07	7.81	0.26	
74.00	5.33	380.50	346.00	0.18	1.14	0.61	1.93	6.00	4.07	10.10	0.40	
60.00	3.17	393.00	707.00	0.18	1.14	0.61	1.93	4.00	2.07	19.76	0.10	
93.00	0.92	420.00	342.00	0.18	1.14	0.61	1.93	3.50	1.57	10.38	0.15	
7.00	1.83	440.00	341.00	0.18	1.14	0.61	1.93	9.00	7.07	10.50	0.67	
12.00	2.00	464.25	640.00	0.18	1.14	0.61	1.93	8.50	6.57	17.11	0.38	
5.00	3.00	469.00	541.00	0.18	1.14	0.61	1.93	5.50	3.57	15.15	0.24	0.25
86.00	3.17	507.33	756.00	0.18	1.14	0.61	1.93	2.00	0.07	19.91	0.00	
76.00	2.58	512.75	514.00	0.18	1.14	0.61	1.93	4.00	2.07	14.74	0.14	
89.00	1.92	514.67	280.00	0.18	1.14	0.61	1.93	3.00	1.07	9.72	0.00	
69.00	1.50	527.67	296.00	0.18	1.14	0.61	1.93	7.00	5.07	10.16	0.50	
72.00	3.50	527.67	425.00	0.18	1.14	0.61	1.93	9.00	7.07	12.93	0.55	
71.00	3.50	527.67	347.00	0.18	1.14	0.61	1.93	4.00	2.07	11.26	0.18	
70.00	0.67	527.67	293.00	0.18	1.14	0.61	1.93	5.50	3.57	10.09	0.35	
68.00	1.42	527.67	559.00	0.18	1.14	0.61	1.93	4.50	2.57	15.82	0.16	
8.00	5.42	528.25	466.00	0.18	1.14	0.61	1.93	6.50	4.57	13.82	0.33	
9.00	5.25	535.00	1263.00	0.18	1.14	0.61	1.93	4.50	2.57	31.02	0.08	
66.00	2.08	550.00	560.00	0.18	1.14	0.61	1.93	6.50	4.57	16.17	0.28	
6.00	1.83	562.20	363.00	0.18	1.14	0.61	1.93	8.00	6.07	11.85	0.51	
4.00	1.83	620.67	249.00	0.18	1.14	0.61	1.93	2.50	0.57	9.81	0.00	
75.00	2.00	632.00	532.00	0.18	1.14	0.61	1.93	7.00	5.07	15.99	0.32	
65.00	2.75	637.00	412.00	0.18	1.14	0.61	1.93	14.50	12.57	13.44	0.94	
10.00	1.50	646.50	474.00	0.18	1.14	0.61	1.93	3.00	1.07	14.84	0.00	
58.00	0.67	711.75	253.00	0.18	1.14	0.61	1.93	8.50	6.57	10.55	0.62	
51.00	0.58	721.75	1375.00	0.18	1.14	0.61	1.93	3.50	1.57	34.78	0.05	
43.00	3.33	723.00	513.00	0.18	1.14	0.61	1.93	3.00	1.07	16.23	0.00	
44.00	1.17	723.00	292.00	0.18	1.14	0.61	1.93	10.00	8.07	11.47	0.70	
21.00	1.25	735.00	509.00	0.18	1.14	0.61	1.93	6.00	4.07	16.23	0.25	
14.00	4.58	747.00	692.00	0.18	1.14	0.61	1.93	9.00	7.07	20.26	0.35	0.29
41.00	4.58	756.00	680.00	0.18	1.14	0.61	1.93	7.50	5.57	19.59	0.28	
22.00	1.50	768.00	475.00	0.18	1.14	0.61	1.93	7.00	5.07	15.73	0.32	
24.00	4.33	817.00	1037.00	0.18	1.14	0.61	1.93	7.50	5.57	28.18	0.20	
15.00	1.00	872.00	1067.00	0.18	1.14	0.61	1.93	6.00	4.07	29.22	0.14	
46.00	5.58	876.00	685.00	0.18	1.14	0.61	1.93	4.00	2.07	19.31	0.11	
48.00	1.67	876.00	670.00	0.18	1.14	0.61	1.93	6.00	4.07	20.08	0.19	
47.00	1.08	876.00	603.00	0.18	1.14	0.61	1.93	3.50	1.57	19.26	0.08	
109.00	5.92	895.00	459.00	0.18	1.14	0.61	1.93	4.00	2.07	16.30	0.13	
2.00	1.75	911.00	598.00	0.18	1.14	0.61	1.93	3.00	1.07	19.41	0.00	
3.00	2.10	936.00	1110.00	0.18	1.14	0.61	1.93	5.50	3.57	30.61	0.12	
1.00	1.28	974.00	710.00	0.18	1.14	0.61	1.93	9.00	7.07	22.44	0.31	
18.00	3.50	990.00	3602.00	0.18	1.14	0.61	1.93	2.00	0.07	84.64	0.00	
16.00	1.83	999.00	617.00	0.18	1.14	0.61	1.93	6.00	4.07	20.45	0.20	0.16

TABLE A-2 (continued)
MIDVALE HOUSE DUST, SOIL AND BLOOD LEAD DATA
CALCULATED PERCENT LEAD ABSORBTION FROM SOIL AND DUST
SORTED BY GROUPINGS OF SOIL LEAD CONCENTRATION

61.00	0.67	1009.40	831.00	0.18	1.14	0.61	1.93	13.50	11.57	25.13	0.46	
63.00	4.83	1009.40	2274.00	0.18	1.14	0.61	1.93	5.00	3.07	56.19	0.05	
45.00	1.92	1015.50	926.00	0.18	1.14	0.61	1.93	3.50	1.57	27.22	0.06	
87.00	4.58	1078.00	405.00	0.18	1.14	0.61	1.93	5.00	3.07	10.17	0.17	
19.00	3.58	1148.00	567.00	0.18	1.14	0.61	1.93	16.50	14.57	20.44	0.71	
32.00	1.92	1230.00	758.00	0.18	1.14	0.61	1.93	10.50	8.57	25.14	0.34	
39.00	4.08	1301.00	1605.00	0.18	1.14	0.61	1.93	13.00	11.07	43.08	0.25	
11.00	1.42	1391.00	1196.00	0.18	1.14	0.61	1.93	6.00	4.07	35.72	0.11	
27.00	1.33	1596.50	736.00	0.18	1.14	0.61	1.93	3.00	1.07	27.30	0.00	
60.00	1.08	1659.00	1313.00	0.18	1.14	0.61	1.93	5.50	3.57	40.17	0.09	
17.00	3.33	1680.50	1343.00	0.18	1.14	0.61	1.93	15.50	13.57	40.97	0.33	
64.00	3.92	1727.00	1138.00	0.18	1.14	0.61	1.93	5.00	3.07	36.09	0.08	
23.00	5.92	1761.75	651.00	0.18	1.14	0.61	1.93	5.50	3.57	26.65	0.13	
31.00	4.17	2351.50	756.00	0.18	1.14	0.61	1.93	8.00	6.07	33.14	0.18	0.21

PRP COMMITTEE FOR THE NL INDUSTRIES/TARACORP SITE

Contact:

Dennis P. Reis
Sidley & Austin
One First National Plaza
Suite 5400
Chicago, IL 60603

October 24, 1990

Brad Bradley (5HS-11)
United States Environmental
Protection Agency
Remedial and Enforcement
Response Branch
230 South Dearborn Street
Chicago, IL 60604

Re: NL Industries/Taracorp Site, Granite City, IL

Dear Mr. Bradley:

We are writing on behalf of the parties identified in Attachment A to supplement the offer we forwarded to you on August 31, 1990 regarding the site referenced above. Based on discussions between the Remedial Project Manager and the Technical Subcommittee of the PRP Committee for the NL Industries/Taracorp Site, we propose that the members of the PRP Committee commit to perform discrete tasks listed in the Record of Decision issued by the United States Environmental Protection Agency ("U.S. EPA") regarding the site. The work we would agree to perform is summarized in Attachment B.

As with the August 31 offer, this supplement is made without any admission of fact or liability by any of the parties listed in Exhibit A, and each party reserves all rights it may have at law or in equity to maintain or defend against any claim or demand whatsoever concerning the Granite City site and surrounding area. Also, this supplement to the original offer should not be construed in any way as diminishing the validity of previous comments on U.S. EPA's Record of Decision. Rather, we are seeking to resolve potential liability to the United States through a negotiated compromise.

In return for performance of the tasks referenced in Attachment B, we request appropriate language in a consent decree to protect members of our group from liability for other site activities. We would seek to negotiate appropriate releases, covenants not to sue, reopener clauses and similar protective provisions.

It is our intention to include in any consent decree which may result from our negotiations with U.S. EPA as many similarly situated parties as care to join, including any of the 362 parties identified by U.S. EPA in its PRP database incoming transactions list. The PRP group's Allocation and De Minimis Party Subcommittees are currently structuring a settlement among such parties to fund our proposal. We would expect U.S. EPA to be receptive to including in a Consent Decree appropriate de minimis party provisions. We would retain our rights to pursue cost recovery and contribution from entities not a party to the consent decree.

We are anxious to begin negotiations toward final resolution of RD/RA related activities and will make ourselves available at your earliest convenience to meet. If you have any questions or comments, please call me (853-2659).

Yours very truly,

Dennis P. Reis

DPR:jdt

cc: Steven Siegel
Parties Listed on Exhibit A
Site PRP Group

ATTACHMENT A

SUPPLEMENTAL GOOD FAITH OFFER PARTICIPANTS

Ace Comb Company Inc.
Allied-Signal Inc. (for C&D Battery)
Allied-Signal Inc. (for Prestolite Battery)
Alter Trading Corporation
Asarco Incorporated
Ashley Salvage Co., Inc.
AT&T
Beldon Scrap & Steel, Inc.
Berlinsky Scrap Corp.
Bob Keller Battery Warehouse, Inc.
Bryan Manufacturing Company
Campbell Soup Company
CBC, Inc.
Cedartown Industries, Inc.
Chrysler Corporation
C. L. Downey Company
CNC Industries, Inc.
Coilcraft (for Otis Radio & Electric Corp.)
Cooper Industries (for The Bussmann Division of McGraw-Edison)
Crown Cork & Seal Co.
Douglas Battery Manufacturing Co.
Exide Corporation (for ESB)
Exide Corporation (for General Battery Corporation)
Federal Cartridge Corporation
Ford Motor Company
General Motors Corporation
General Motors Corporation (for Delco-Remy Div. of G.M.)
General Motors Corporation (for Fisher Body Div. of G.M.)
General Waste Products, Inc.
Gopher Smelting and Refining Co.
Gould, Inc.
Hornady Mfg. (for Western Gun & Supply)
Imperial Smelting Corporation
J. Solomon & Sons, Inc.
Johnson Controls (for Globe Union)
Lopez Scrap Metal, Inc.
Kamen Iron & Metal of Kamen, Inc.
M. Katch & Co., Inc.
Mallin Bros. Co.
Mayfield Manufacturing Company (for 3-H Industries)
Mid-Missouri Metals Corp.
Missouri Iron & Metal Company, Inc.
M. Gervich & Sons Incorporated
Morris Tick Company, Inc.
Northwestern Bell Telephone Co. dba/ US West Communications
Olin Corporation

Overland Metals
Pet Incorporated
Phillip Brothers, Inc.
Price-Watson Company
Ranken Technical Institute
RBS Industries, Inc. (for Milford Rivet and Machine Company)
Rich Metals Co.
Roth Brothers Smelting Corporation
Samuel Hide & Metal Co., Inc.
Sanders Lead Co., Inc.
Shapiro Brothers
Shapiro Sales Co.
Sioux City Compressed Steel
Sol Tick, Inc. (d/b/a Herb Tick, Inc.)
Strauss Industries (for Herman Strauss, Inc.)
U.S. Department of Energy (for Stanford Linear Accelerator)
U.S.S. Lead Refinery, Inc.
Waddell Bros. Metal Co.
Wallach Iron & Metal
World Color Press, Inc.-Spartan Printing Division

ATTACHMENT B

Soil Sampling/Inspection

Soil lead sampling shall be conducted in Area 1 to determine the depth of excavation to achieve a 1000 ppm level. The excavation will not exceed the depth required for proper asphalting.

Taracorp Drums

All drums on the Taracorp pile shall be removed and transported to an off-site secondary lead smelter for lead recovery.

SLLR Pile

All Wastes contained in the SLLR pile shall be consolidated into the Taracorp pile.

Area 1

Based on the sampling outlined in the Soil Sampling/Transaction paragraph above, all unpaved portions of Area 1, including the material which is beneath the SLLR pile, with lead concentrations greater than 1000 ppm shall be excavated and consolidated with the Taracorp pile. The surfaces shall be restored with asphalt or seed, in accordance with present usage. Areas of heavy vehicle traffic will require a minimum 12" excavation prior to asphalting.

Dust Control Measures

During all excavation, transportation, and consolidation activities conducted as part of the remedy, dust control measures shall be implemented as necessary to prevent the generation of visible emissions during these activities.

RCRA-Complaint Multimedia Cap

After all materials have been transported to and consolidated with the Taracorp pile, the consolidated pile shall be graded and capped with a RCRA-complaint, multimedia cap. The cap shall be constructed as indicated in Figure 8 (or an EPA approved alternative) and shall meet or exceed the requirements of RCRA Subtitle C, and Illinois State law. The proposed construction does not lie within any floodway in the area.

Bottom Liner

With the exception of the existing Taracorp pile, a clay bottom liner shall be constructed on all areas upon which consolidated material are to be placed as part of this remedy. Portions of this liner on Area 1 shall be constructed after Area 1 has been excavated to a 1000 ppm lead cleanup level.

Institutional Controls/Fencing

Institutional controls, such as site access restrictions, restrictive covenants, deed restrictions, and property transfer restrictions, shall be implemented for the properties which contain the expanded Taracorp pile to prohibit future development of the site and any activities that would in any way reduce the effectiveness of the cap in achieving remedial action goals.

The facility shall be fenced in a manner sufficient to prevent access to the expanded Taracorp pile. Warning signs shall be posted at 200-foot intervals along the advising that the area is hazardous due to chemicals in the waste materials and soils beneath the cap which may pose a risk to public health.

Groundwater Monitoring

A minimum of one upgradient and three downgradient deep wells shall be installed to monitor water quality in the lower portion of the upper aquifer. Monitoring of these wells and the 14 existing site wells shall be conducted semi-annually during the remediation. Analyses will include a full scan Hazardous Substance List organics and inorganics.

Air Monitoring

Air monitoring for lead and PM_{10} (particular matter less than 10 microns) shall be performed during the remediation. The frequency of this sampling will be determined in the Health and Safety Plan.

Drainage Control

Engineering controls will be implemented to minimize contaminant transport during the remediation.